Servo Motor Control Protocol V3.8

Disclaimer

Catalogue

1. Communication Bus Parameters and Message Format

1.1.CAN Bus

1.1.1. Parameters

Bus interface: CAN
Baud rate: 1Mbps

1.1.2. Message format

Identifier: Single motor command sending: 0x140 + ID(1~32)
Multi-motor command sending: 0x280
Reply: 0x240 + ID (1~32)
Frame format: data frame
Frame Type: Standard Frame
DLC: 8 bytes

1.2.RS485 bus

1.2.1. Parameters

Bus interface: RS485
Baudrate:115200bps，500Kbps，1Mbps，1.5Mbps，2Mbps.

1.2.2. Message format

Type	Data Defination	Bytes	Description
Frame header	0x3E	1	Communication frame header, used for identification.
ID	1~32	1	Device address, corresponding to the ID number of each motor.
Data Length	Data Length	1	The length of the data field. In the standard protocol, the length is fixed to 8 bytes.

Data field	Data content	According to the length	The content of the data field in the standard protocol is exactly the same as that of the CAN.
Check	CRC Check	2	CRC16 check, low order first, high order last.

2. Single motor command description

2.1. Read PID parameter command (0x30)

2.1.1. Instruction description

This command can read the parameters of current, speed, position loop KP and KI at one time, and the data type is uint8_t. The system sets the maximum range of PI parameters according to the motor model, and then divides it equally according to the maximum range of uint8_t of 256 units. Users only need to adjust 0-256 units.

2.1.2. Send data field definition

Data field	**Description**	**Data**
DATA[0]	Command byte	0x30
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	NULL	0x00

2.1.3. Reply data field definition

Data field	Description	Data
DATA[0]	Command byte	0x30
DATA[1]	NULL	0x00
DATA[2]	Current loop KP parameters	DATA[2] = (uint8_t)(CurrKP)

DATA[3]	Current loop KI parameters	DATA[3] = (uint8_t)(CurrKI)
DATA[4]	Speed loop KP parameters	DATA[4] = (uint8_t)(SpdKP)
DATA[5]	Speed loop KI parameters	DATA[5] = (uint8_t)(SpdKI)
DATA[6]	Position loop KP parameters	DATA[6] = (uint8_t)(PosKP)
DATA[7]	Position loop KI parameters	DATA[7] = (uint8_t)(PosKI)

2.1.4. Communication example

Example 1:

Send command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0x30	0x00	0x00	0x00	0x00	0x00	0x00	0x00

RS485:

Frame Header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x30	0x00	0x00	0x00	0x00	0x00	0x00	0x30	CRC16L	CRC16H

Description: Send command to read PID parameters.

Reply command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0x30	0x00	0x55	0x19	0x55	0x19	0x55	0x19

RS485:

Frame Header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x30	0x00	0x55	0x19	0x55	0x19	0x55	0x19	CRC16L	CRC16H

Description:

Data[2] represents the current loop KP parameter, 0x55 decimal represents 85, assuming that the maximum value of the current loop set by the system is 3, then the actual value of 1 unit is 3/256 = 0.01171875, and 85 units represent the actual value 85*0.01171875 = 0.99609375, which is the actual value of the KP parameter of the current loop inside the system.

Data[3] represents the current loop KI parameter, 0x19 decimal represents 25, assuming that the maximum value of the current loop set by the system is 0.1, then the actual value of 1 unit is 0.1/256 = 0.00039062, and 25 units represent the actual value of 25* 0.00039062 = 0.0097656, which is the actual value of the KI parameter of the current loop inside the system.

Data[4] represents the KP parameter of the speed loop, and 0x55 in decimal represents 85. Assuming that the maximum value of the speed loop set by the system is 0.1, the actual value of 1 unit is 0.1/256 = 0.00039062, and 85 units represent the actual value of 85* 0.00039062 = 0.0332027, this is the actual value of the KP parameter of the internal speed loop of the system.

Data[5] represents the speed loop KI parameter, 0x19 decimal represents 25, assuming that the maximum speed loop set by the system is 0.01, then the actual value of 1 unit is 0.01/256 = 0.00003906, and 25 units means the actual value is 25* 0.00003906 = 0.0009765, this is the actual value of the KI parameter of the speed loop inside the system.

Data[6] represents the KP parameter of the position loop, 0x55 in decimal means 85, assuming that the maximum value of the position loop set by the system is 0.1, then the actual value of 1 unit is 0.1/256 = 0.00039062, and 85 units means the actual value is 85* 0.00039062 = 0.0332027, this is the actual value of the KP parameter of the internal position loop of the system.

Data[7] represents the position loop KI parameter, 0x19 decimal represents 25, assuming that the maximum value of the position loop set by the system is 0.01, then the actual value of 1 unit is 0.01/256 = 0.00003906, and 25 units means the actual value is 25* 0.00003906 = 0.0009765, which is the actual value of the KI parameter of the internal position loop of the system.

2.2. Write PID parameters to RAM command (0x31)

2.2.1. Instruction description

This command can write the parameters of current, speed, position loop KP and KI to RAM at one time, and it will not be saved after power off. The data type is uint8_t. The system sets the maximum range of PI parameters according to the motor model, and then divides it equally according to the maximum range of uint8_t of 256 units. Users only need to adjust 0-256 units.

2.2.2. Send data field definition

Data field	Description	Data
DATA[0]	Command byte	0x31
DATA[1]	NULL	0x00
DATA[2]	Current loop KP parameter	DATA[2] = (uint8_t)(CurrKP)
DATA[3]	Current loop KI parameter	DATA[3] = (uint8_t)(CurrKI)
DATA[4]	Speed loop KP parameter	DATA[4] = (uint8_t)(SpdKP)
DATA[5]	Speed loop KI parameter	DATA[5] = (uint8_t)(SpdKI)
DATA[6]	Position loop KP parameter	DATA[6] = (uint8_t)(PosKP)
DATA[7]	Position loop KI parameter	DATA[7] = (uint8_t)(PosKI)

2.2.3. Reply data field definition

The content of the reply data is the same as the sent data.

2.2.4. Communication example

Example 1:
Send command:
CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0x31	0x00	0x55	0x19	0x55	0x19	0x55	0x19

RS485:

Frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x31	0x00	0x55	0x19	0x55	0x19	0x55	0x19	CRC16L	CRC16H

Description:

Data[2] represents the current loop KP parameter, 0x55 decimal represents 85, assuming that the maximum current loop set by the system is 3, then the actual value of 1 unit is 3/256 = 0.01171875, and 85 units represent the actual value of 85* 0.01171875 = 0.99609375, which is the actual value of the KP parameter of the current loop inside the system.

Data[3] represents the current loop KI parameter, 0x19 decimal represents 25, assuming that the maximum value of the current loop set by the system is 0.1, then the actual value of 1 unit is 0.1/256 = 0.00039062, and 25 units represent the actual value of 25* 0.00039062 = 0.0097656, which is the actual value of the KI parameter of the current loop inside the system.

Data[4] represents the KP parameter of the speed loop, and 0x55 in decimal represents 85. Assuming that the maximum value of the speed loop set by the system is 0.1, the actual value of 1 unit is 0.1/256 = 0.00039062, and 85 units represent the actual value of 85* 0.00039062 = 0.0332027, this is the actual value of the KP parameter of the internal speed loop of the system.

Data[5] represents the speed loop KI parameter, 0x19 decimal represents 25, assuming that the maximum speed loop set by the system is 0.01, then the actual value of 1 unit is 0.01/256 = 0.00003906, and 25 units means the actual value is 25* 0.00003906 = 0.0009765, this is the actual value of the KI parameter of the speed loop inside the system.

Data[6] represents the KP parameter of the position loop, 0x55 in decimal means 85, assuming that the maximum value of the position loop set by the system is 0.1, then the actual value of 1 unit is 0.1/256 = 0.00039062, and 85 units means the actual value is 85* 0.00039062 = 0.0332027, this is the actual value of the KP parameter of the internal position loop of the system.

Data[7] represents the position loop KI parameter, 0x19 decimal represents 25, assuming that the maximum value of the position loop set by the system is 0.01, then the actual value of 1 unit is 0.01/256 = 0.00003906, and 25 units means the actual value is 25* 0.00003906 = 0.0009765, which is the actual value of the KI parameter of the internal position loop of the system.

Reply command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0x31	0x00	0x55	0x19	0x55	0x19	0x55	0x19

RS485:

Frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x31	0x00	0x55	0x19	0x55	0x19	0x55	0x19	CRC16L	CRC16H

2.3. Write PID parameters to ROM command (0x32)

2.3.1. Instruction description

This command can write the parameters of current, speed, position loop KP and KI to ROM at one time, which can be saved after power off. The data type is uint8_t. The system sets the maximum range of PI parameters according to the motor model, and then divides it equally according to the maximum range of uint8_t of 256 units. Users only need to adjust 0-256 units.

2.3.2. Send data field definition

Data Field	Description	Data
DATA[0]	command byte	0x32
DATA[1]	NULL	0x00
DATA[2]	Current loop KP parameters	DATA[2] = (uint8_t)(CurrKP)
DATA[3]	Current loop KI parameters	DATA[3] = (uint8_t)(CurrKI)
DATA[4]	Speed loop KP parameters	DATA[4] = (uint8_t)(SpdKP)
DATA[5]	Speed loop KI parameters	DATA[5] = (uint8_t)(SpdKI)
DATA[6]	Position loop KP parameters	DATA[6] = (uint8_t)(PosKP)
DATA[7]	Position loop KI parameters	DATA[7] = (uint8_t)(PosKI)

2.3.3. Reply data field definition

The content of the reply data is the same as the sent data.

2.3.4. Communication example

Example 1:
Send command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0x32	0x00	0x55	0x19	0x55	0x19	0x55	0x19

RS485：

frame header	ID	length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x32	0x00	0x55	0x19	0x55	0x19	0x55	0x19	CRC16L	CRC16H

Description:

Data[2] represents the current loop KP parameter, 0x55 decimal represents 85, assuming that the maximum value of the current loop set by the system is 3, then the actual value of 1 unit is 3/256 = 0.01171875, and 85 units represent the actual value 85*0.01171875 = 0.99609375, which is the actual value of the KP parameter of the current loop inside the system.

Data[3] represents the current loop KI parameter, 0x19 decimal represents 25, assuming that the maximum value of the current loop set by the system is 0.1, then the actual value of 1 unit is 0.1/256 = 0.00039062, and 25 units represent the actual value of 25* 0.00039062 = 0.0097656, which is the actual value of the KI parameter of the current loop inside the system.

Data[4] represents the KP parameter of the speed loop, and 0x55 in decimal represents 85. Assuming that the maximum value of the speed loop set by the system is 0.1, the actual value of 1 unit is 0.1/256 = 0.00039062, and 85 units represent the actual value of 85* 0.00039062 = 0.0332027, this is the actual value of the KP parameter of the internal speed loop of the system.

Data[5] represents the speed loop KI parameter, 0x19 decimal represents 25, assuming that the maximum speed loop set by the system is 0.01, then the actual value of 1 unit is 0.01/256 = 0.00003906, and 25 units means the actual value is 25* 0.00003906 = 0.0009765, this is the actual value of the KI parameter of the speed loop inside the system.

Data[6] represents the KP parameter of the position loop, 0x55 in decimal means 85, assuming that the maximum value of the position loop set by the system is 0.1, then the actual value of 1 unit is 0.1/256 = 0.00039062, and 85 units means the actual value is 85* 0.00039062 = 0.0332027, this is the actual value of the KP parameter of the internal position loop of the system.

Data[7] represents the position loop KI parameter, 0x19 decimal represents 25, assuming that the maximum value of the position loop set by the system is

0.01, then the actual value of 1 unit is 0.01/256 = 0.00003906, and 25 units means the actual value is 25* 0.00003906 = 0.0009765, which is the actual value of the KI parameter of the internal position loop of the system.

Reply command:
CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0x32	0x00	0x55	0x19	0x55	0x19	0x55	0x19

RS485：

frame header	ID	length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x32	0x00	0x55	0x19	0x55	0x19	0x55	0x19	CRC16L	CRC16H

2.4. Read acceleration command (0x42)

2.4.1. Instruction description

The host sends this command to read the acceleration parameters of the current motor

2.4.2. Send data field definition

data field	Description	Data
DATA[0]	command byte	0x42
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	NULL	0x00

2.4.3. Reply data field definition

The acceleration parameter is included in the drive response data. Acceleration data Accel is int32_t type, the unit is 1dps/s, and the parameter range is 50-60000.

data field	Description	Data
DATA[0]	command byte	0x42
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	Acceleration low byte 1	DATA[4] = (uint8_t)(Accel)
DATA[5]	acceleration byte 2	DATA[5] = (uint8_t)(Accel>>8)
DATA[6]	acceleration byte 3	DATA[6] = (uint8_t)(Accel>>16)
DATA[7]	acceleration byte 4	DATA[7] = (uint8_t)(Accel>>24)

2.4.4. Communication example

Example 1:
Send command:
CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0x42	0x00	0x00	0x00	0x00	0x00	0x00	0x00

RS485：

frame header	ID	length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x42	0x00	0x00	0x00	0x10	0x27	0x00	0x00	CRC16L	CRC16H

Description:
Data[4] to data[7] form one (Data[4] is the lowest bit, Data[7] is the highest bit) 32-bit data is 0x00002710, which means 10000 in decimal. It means that the acceleration of the motor position loop is 10000dps/s.

2.5. Write acceleration to RAM and ROM command (0x43)

2.5.1. Instruction description

The host sends this command to write the acceleration and deceleration into RAM and ROM, which can be saved after power off. Acceleration data Accel is of uint32_t type, the unit is 1dps/s, and the parameter range is 100-60000. The command contains the acceleration and deceleration values in the position and velocity planning, which are determined by the index value. For details, see the index description table in 2.5.4.

2.5.2. Send data field definition

data field	Description	data
DATA[0]	command byte	0x43
DATA[1]	function inde	DATA[1] = (uint8_t)index
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	Acceleration low byte 1	DATA[4] = (uint8_t)(Accel)
DATA[5]	acceleration byte 2	DATA[5] = (uint8_t)(Accel>>8)
DATA[6]	acceleration byte 3	DATA[6] = (uint8_t)(Accel>>16)
DATA[7]	acceleration byte 4	DATA[7] = (uint8_t)(Accel>>24)

2.5.3. Reply data field definition

The motor will reply to the host after receiving the command, and the reply command is the same as the received command.

2.5.4. Function Index Description

Index value	Command name	Function description
0x00	position planning acceleration	Acceleration value from initial velocity to maximum velocity in position planning
0x01	Position planning deceleration	Deceleration value from maximum speed to stop in position planning
0x02	speed planning acceleration	The acceleration value from the current speed to the target speed, including the acceleration in the forward and reverse directions
0x03	speed planning deceleration	In the same direction, the deceleration value from the current speed to the target speed

2.5.5 Communication example

Example 1:

Send command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]

0x141	0x43	0x00	0x00	0x00	0x10	0x27	0x00	0x00

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x43	0x00	0x00	0x00	0x10	0x27	0x00	0x00	CRC16L	CRC16H

Description:
Data[1] is 0x00, indicating the position planning acceleration value. Data[4] to data[7] form one (Data[4] is the lowest bit, Data[7] is the highest bit) 32-bit data is 0x00002710, which means 10000 in decimal. Indicates that the position planning acceleration of 10000dps/s is written to the motor driver, and the value can be saved after the power is turned off.

Reply command:
CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0x43	0x00	0x00	0x00	0x10	0x27	0x00	0x00

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x43	0x00	0x00	0x00	0x10	0x27	0x00	0x00	CRC16L	CRC16H

Description: The motor replies to the host after receiving the command, and the reply command is the same as the received command.

Example 2:
Send command:
CAN:

ID 号	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0x43	0x01	0x00	0x00	0x10	0x27	0x00	0x00

RS485:

帧头	ID 号	长度	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x43	0x01	0x00	0x00	0x10	0x27	0x00	0x00	CRC16L	CRC16H

Description: Data[1] is 0x01, indicating the deceleration value of position planning. Data[4] to data[7] form one (Data[4] is the lowest bit, Data[7] is the highest bit) 32-bit data is 0x00002710, which means 10000 in decimal. Indicates that the position planning deceleration of 10000dps/s is written to the motor driver, and the value can be saved after the power is turned off.

Reply command:
CAN:

ID 号	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0x43	0x01	0x00	0x00	0x10	0x27	0x00	0x00

RS485:

帧头	ID 号	长度	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x43	0x01	0x00	0x00	0x10	0x27	0x00	0x00	CRC16L	CRC16H

Description: The motor replies to the host computer after receiving the command, and the reply command is the same as the received command.

Example 3:
Send command:
CAN:

ID 号	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0x43	0x02	0x00	0x00	0x10	0x27	0x00	0x00

RS485:

帧头	ID 号	长度	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x43	0x02	0x00	0x00	0x10	0x27	0x00	0x00	CRC16L	CRC16H

Description: Data[1] is 0x02, which indicates the acceleration value of speed planning. Data[4] to data[7] form one (Data[4] is the lowest bit, Data[7] is the highest bit) 32-bit data is 0x00002710, which means 10000 in decimal. Indicates that the speed planning acceleration of 10000dps/s is written to the motor driver, and the value can be saved after power off.

Reply command:
CAN:

ID 号	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0x43	0x02	0x00	0x00	0x10	0x27	0x00	0x00

RS485:

帧头	ID 号	长度	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x43	0x02	0x00	0x00	0x10	0x27	0x00	0x00	CRC16L	CRC16H

Description: The motor replies to the host after receiving the command, and the reply command is the same as the received command.

Example 4:
Send command:
CAN:

ID 号	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0x43	0x03	0x00	0x00	0x10	0x27	0x00	0x00

RS485:

帧头	ID 号	长度	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x43	0x03	0x00	0x00	0x10	0x27	0x00	0x00	CRC16L	CRC16H

Description: Data[1] is 0x03, indicating the speed planning deceleration value. Data[4] to data[7] form one (Data[4] is the lowest bit, Data[7] is the highest bit) 32-bit data is 0x00002710, which means 10000 in decimal. Indicates that the speed planning deceleration of 10000dps/s is written to the motor driver, and the value can be saved after the power is turned off.

Reply command:
CAN:

ID 号	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0x43	0x03	0x00	0x00	0x10	0x27	0x00	0x00

RS485:

帧头	ID 号	长度	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x43	0x03	0x00	0x00	0x10	0x27	0x00	0x00	CRC16L	CRC16H

Description: The motor replies to the host after receiving the command, and the reply command is the same as the received command.

2.6. Read multi-turn encoder position data command (0x60)

2.6.1. Instruction description

The host sends this command to read the multi-turn position of the encoder, which represents the rotation angle of the motor output shaft, including the multi-turn angle.

2.6.2. Send data field definition

data field	Description	data
DATA[0]	command byte	0x60
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	NULL	0x00

2.6.3. Reply data field definition

The motor replies to the host after receiving the command, and the frame data contains the following parameters. Encoder multi-turn position encoder (int32_t type, value range of multi-turn encoder, 4 bytes of valid data), which is the value after subtracting the encoder's multi-turn zero offset (initial position) from the original position of the encoder.

data field	Description	data
DATA[0]	command byte	0x60
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	Encoder position low byte 1	DATA[4] = (uint8_t)(encoder)
DATA[5]	encoder position byte 2	DATA[5] = (uint8_t)(encoder>>8)
DATA[6]	encoder position byte 3	DATA[6] = (uint8_t)(encoder>>16)
DATA[7]	encoder position byte 4	DATA[7] = (uint8_t)(encoder>>24)

2.6.4. Communication example

Example 1:
Send command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0x60	0x00	0x00	0x00	0x00	0x00	0x00	0x00

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x60	0x00	0x00	0x00	0x10	0x27	0x00	0x00	CRC16L	CRC16H

Description: The host sends this command to read the multi-turn position of the encoder.

Reply command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0x60	0x00	0x00	0x00	0x10	0x27	0x00	0x00

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x60	0x00	0x00	0x00	0x10	0x27	0x00	0x00	CRC16L	CRC16H

Description: Data[4] to data[7] form one (Data[4] is the lowest bit, Data[7] is the highest bit) 32-bit data is 0x00002710, which means 10000 in decimal. The multi-turn encoder value representing the current relative multi-turn zero offset (initial position) of the motor is 10000 pulses.

2.7. Read multi-turn encoder original position data command (0x61)

2.7.1. Instruction description

The host sends this command to read the multi-turn encoder home position, ie the multi-turn encoder value without the zero offset (home position).

2.7.2. Send data field definition

data field	Description	data
DATA[0]	command byte	0x61

DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	NULL	0x00

2.7.3. Reply data field definition

The motor replies to the host after receiving the command, and the frame data contains the following parameters. Encoder multi-turn raw position encoderRaw (int32_t type, value range, valid data 4 bytes).

data field	Description	data
DATA[0]	command byte	0x61
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	Encoder original position byte1	DATA[4] = (uint8_t)(encoderRaw)
DATA[5]	Encoder original position byte 2	DATA[5] = (uint8_t)(encoderRaw>>8)
DATA[6]	Encoder original position byte3	DATA[6] = (uint8_t)(encoderRaw>>16)
DATA[7]	Encoder original position byte4	DATA[7] = (uint8_t)(encoderRaw>>24)

2.7.4. Communication example

Example 1:
Send command:
CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]

0x141	0x61	0x00	0x00	0x00	0x00	0x00	0x00	0x00

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x61	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Description:

The host sends this command to read the original position of the encoder multi-turn.

Reply command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0x61	0x00	0x00	0x00	0x10	0x27	0x00	0x00

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x61	0x00	0x00	0x00	0x10	0x27	0x00	0x00	CRC16L	CRC16H

Description:

Data[4] to data[7] form one (Data[4] is the lowest bit, Data[7] is the highest bit) 32-bit data is 0x00002710, which means 10000 in decimal. Indicates that the current multi-turn encoder value of the motor is 10000 pulses, excluding the zero offset (initial position).

2.8. Read multi-turn encoder zero offset data command (0x62)

2.8.1. Instruction description

The host sends this command to read the multi-turn zero offset value (initial position) of the encoder.

2.8.2. Send data field definition

data field	Description	data
DATA[0]	command byte	0x62
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00

DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	NULL	0x00

2.8.3. Reply data field definition

The motor replies to the host after receiving the command, and the frame data contains the following parameters. Encoder multi-turn zero offset encoderOffset (int32_t type, value range, valid data 4 bytes).

data field	Description	data
DATA[0]	command byte	0x62
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	Encoder Offset Byte 1	DATA[4] = (uint8_t)(encoderOffset)
DATA[5]	Encoder Offset Byte2	DATA[5] = (uint8_t)(encoderOffset>>8)
DATA[6]	Encoder Offset Byte3	DATA[6] = (uint8_t)(encoderOffset>>16)
DATA[7]	Encoder Offset Byte4	DATA[7] = (uint8_t)(encoderOffset>>24)

2.8.4. Communication example

Example 1:

Send command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0x62	0x00	0x00	0x00	0x00	0x00	0x00	0x00

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x62	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Description:
The host sends this command to read the multi-turn zero offset value of the encoder.

Reply command:
CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0x62	0x00	0x00	0x00	0x10	0x27	0x00	0x00

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x62	0x00	0x00	0x00	0x10	0x27	0x00	0x00	CRC16L	CRC16H

Description:
Data[4] to data[7] form one (Data[4] is the lowest bit, Data[7] is the highest bit) 32-bit data is 0x00002710, which means 10000 in decimal. Indicates that the current multi-turn encoder zero offset value of the motor is 10000 pulses.

2.9. Write encoder multi-turn value to ROM as motor zero command (0x63)

2.9.1. Instruction description

The host sends this command to set the zero offset (initial position) of the encoder, where the encoder multi-turn value to be written, encoderOffset, is of type int32_t, (value range, 4 bytes of valid data).
Note: After writing the position of the new zero point, the motor needs to be restarted to be effective. Because of the change of the zero offset, the new zero offset (initial position) should be used as a reference when setting the target position.

2.9.2. Send data field definition

data field	Description	data
DATA[0]	command byte	0x63
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00

DATA[4]	Encoder zero bias low byte 1	DATA[4] = (uint8_t)(encoderOffset)
DATA[5]	Encoder Offset Byte2	DATA[5] = (uint8_t)(encoderOffset>>8)
DATA[6]	Encoder Offset Byte3	DATA[6] = (uint8_t)(encoderOffset>>8)
DATA[7]	Encoder Offset Byte4	DATA[7] = (uint8_t)(encoderOffset>>8)

2.9.3. Reply data field definition

The motor replies to the host after receiving the command, and the frame data is the same as the command sent by the host.

2.9.4. Communication example

Example 1:
Send command:
CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0x63	0x00	0x00	0x00	0x10	0x27	0x00	0x00

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x63	0x00	0x00	0x00	0x10	0x27	0x00	0x00	CRC16L	CRC16H

Description:
Data[4] to data[7] form one (Data[4] is the lowest bit, Data[7] is the highest bit) 32-bit data is 0x00002710, which means 10000 in decimal. It means to write 10000 pulses as multi-turn encoder zero offset.
Reply command:
CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0x63	0x00	0x00	0x00	0x10	0x27	0x00	0x00

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x63	0x00	0x00	0x00	0x10	0x27	0x00	0x00	CRC16L	CRC16H

Description:
The motor replies to the host after receiving the command, and the frame data is the same as the command sent by the host.

2.10. Write the current multi-turn position of the encoder to the ROM as the motor zero command (0x64)

2.10.1. Instruction description

Write the current encoder position of the motor as the multi-turn encoder zero offset (initial position) into the ROM
Note: After writing the new zero point position, the motor needs to be restarted to be effective. Because of the change of the zero offset, the new zero offset (initial position) should be used as a reference when setting the target position.

2.10.2. Send data field definition

data field	Description	data
DATA[0]	command byte	0x64
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	NULL	0x00

2.10.3. Reply data field definition

The motor replies to the host after receiving the command, and the encoderOffset in the data is the set zero offset value.

data field	Description	data
DATA[0]	command byte	0x64
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00

DATA[4]	Encoder zero bias low byte1	DATA[4] = (uint8_t)(encoderOffset)
DATA[5]	Encoder Offset Byte2	DATA[5] = (uint8_t)(encoderOffset>>8)
DATA[6]	Encoder Offset Byte3	DATA[6] = (uint8_t)(encoderOffset>>16)
DATA[7]	Encoder Offset Byte4	DATA[7] = (uint8_t)(encoderOffset>>24)

2.10.4. Communication example

Example 1:

Send command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0x64	0x00	0x00	0x00	0x00	0x00	0x00	0x00

RS485:

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x64	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Description:

After sending the 0x64 command, the motor will write the current multi-turn encoder value as the zero offset (initial position) into the ROM.

Reply command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0x64	0x00	0x00	0x00	0x10	0x27	0x00	0x00

RS485:

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x64	0x00	0x00	0x00	0x10	0x27	0x00	0x00	CRC16L	CRC16H

Description:

Data[4] to data[7] form one (Data[4] is the lowest bit, Data[7] is the highest bit) 32-bit data is 0x00002710, which means 10000 in decimal. Indicates that the multi-turn zero offset value (initial position) written to the motor is 10,000 pulses.

2.11. Read single-turn encoder command (0x90)

2.11.1. Instruction Description

The host sends this command to read the current position of the encoder. Note that the current command is used as a single-turn data reading command for direct drive motors.

2.11.2. Send data field definition

Data Field	Description	Data
DATA[0]	命令字节	0x90
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	NULL	0x00

2.11.3. Reply data field definition

The motor replies to the host after receiving the command, and the frame data contains the following parameters.

1. The encoder position encoder is the original position of the encoder minus the zero offset of the encoder.
2. The original encoder position encoderRaw.
3. Encoder zero offset encoderOffset, this point is used as the zero point of the motor angle.

Data Field	Description	Data
DATA[0]	Command byte	0x90
DATA[1]	NULL	0x00
DATA[2]	Encoder position low byte	DATA[1] = (uint8_t)(encoder)
DATA[3]	Encoder position high byte	DATA[2] = (uint8_t)(encoder>>8)
DATA[4]	Encoder original position low byte	DATA[3] = (uint8_t)(encoderRaw)
DATA[5]	Encoder original position	DATA[4] = (uint8_t)(encoderRaw>>8)

	high byte	
DATA[6]	Encoder zero bias low byte	DATA[5] = (uint8_t)(encoderOffset)
DATA[7]	Encoder zero bias high byte	DATA[6] = (uint8_t)(encoderOffset>>8)

2.11.4. Example of communication

Example 1:

Send command:

CAN:

ID No.	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0x90	0x00	0x00	0x00	0x00	0x00	0x00	0x00

RS485：

frame header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x90	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Note: After sending the 0x90 command, it will return the motor single-turn encoder value.

Reply command:

CAN:

ID No.	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0x90	0x00	0x33	0x08	0xBE	0x2C	0x8B	0x24

RS485：

Frame Header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x90	0x00	0x33	0x08	0xBE	0x2C	0x8B	0x24	CRC16L	CRC16H

Explanation: Data[2] to data[3] form a (Data[2] is the lowest bit, Data[3] is the highest bit) 16-bit data is 0x0833, which means the decimal system is 2099, which means the current relative zero offset encoder of the motor The position is 2099 pulses. Data[4] to data[5] make up a (Data[4] is the lowest bit, Data[5] is the highest bit) 16-bit data is 0x2CBE, which means that the decimal system is 11454, which means that the current encoder original position of the motor is 11454 pulse. Data[6] to data[7] form a (Data[6] is the lowest bit, Data[7] is the highest bit) 16-bit data is 0x248B, which means that the decimal system is 9355, which means that the zero offset position of the motor is 9355 pulses.

2.12. Read multi-turn angle command (0x92)

2.12.1. Instruction description

The host sends this command to read the current multi-turn absolute angle value of the motor.

2.12.2. Send data field definition

data field	Description	data
DATA[0]	command byte	0x92
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	NULL	0x00

2.12.3. Reply data field definition

The motor replies to the host after receiving the command, and the frame data contains the following parameters.

1. Motor angle motorAngle, (int32_t type, value range, valid data 4 bytes), unit 0.01°/LSB.

data field	Description	data
DATA[0]	command byte	0x92
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	angle low byte 1	DATA[4] = (uint8_t)(motorAngle)
DATA[5]	angle bytes2	DATA[5] = (uint8_t)(motorAngle>>8)
DATA[6]	angle bytes3	DATA[6] = (uint8_t)(motorAngle>>16)
DATA[7]	angle bytes4	DATA[7] = (uint8_t)(motorAngle>>24)

2.12.4. Communication example

Example 1:

Send command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0x92	0x00	0x00	0x00	0x00	0x00	0x00	0x00

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x92	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Description:

After sending the 0x92 command, it will return the absolute angle of the motor output shaft.

Reply command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0x92	0x00	0x00	0x00	0xA0	0x8C	0x00	0x00

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x92	0x00	0x00	0x00	0xA0	0x8C	0x00	0x00	CRC16L	CRC16H

Description:

Data[4] to data[7] form one (Data[4] is the lowest bit, Data[7] is the highest bit) The 32-bit data is 0x00008CA0, which means the decimal is 36000, which is reduced by 100 times in units of 0.01°/LSB That is 36000*0.01=360°. Indicates that the motor output shaft moves 360° in the positive direction relative to the zero position.

2.13. Read single-turn angle command (0x94)

2.13.1. Instruction Description

The host sends this command to read the current single-turn angle of the motor. Note that the current command is used as a single-turn data read command for direct drive motors.

2.13.2. Send data field definition

Data Field	Description	Data
DATA[0]	命令字节	0x94
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	NULL	0x00

2.13.3. Reply data field definition

The motor replies to the host after receiving the command, and the frame data contains the following parameters.

1. The single circle angle of the motor, circleAngle, is int16_t type data. It starts from the zero point of the encoder and increases clockwise. When it reaches the zero point again, the value returns to 0. The unit is 0.01°/LSB, and the value ranges from 0 to 35999.

Data field	Description	Data
DATA[0]	Command byte	0x94
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	Single turn angle low byte	DATA[5] = (uint8_t)(circleAngle)
DATA[7]	Single turn angle high byte	DATA[6] = (uint8_t)(circleAngle>>8)

2.13.4. Example of communication

Example 1:

Send command:

CAN:

ID No.	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0x94	0x00	0x00	0x00	0x00	0x00	0x00	0x00

RS485:

Frame Header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x94	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Note: After sending the 0x94 command, it will return the motor single-turn angle.

Reply command:

CAN:

ID No.	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0x94	0x00	0x00	0x00	0x00	0x00	0x10	0x27

RS485:

Frame Header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x94	0x00	0x00	0x00	0x00	0x00	0x10	0x27	CRC16L	CRC16H

Explanation:

Data[6] to data[7] form a (Data[6] is the lowest bit, Data[7] is the highest bit) 16-bit data is 0x2710, indicating that the decimal system is 10000, and the unit is 0.01°. Indicates that the motor is currently at 100° relative to the zero position.

2.14. Read Motor Status 1 and Error Flag Command (0x9A)

2.14.1. Instruction description

This command reads the current motor temperature, voltage and error status flags

2.14.2. Send data field definition

data field	Description	data
DATA[0]	command byte	0x9A
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	NULL	0x00

2.14.3. Reply data field definition

The motor replies to the host after receiving the command, and the frame data contains the following parameters:

1. Motor temperature temperature (int8_t type, unit 1℃/LSB).
2. Brake control command: Indicates the state of the brake control command, 1 represents the brake release command, and 0 represents the brake lock command.
2. Voltage (uint16_t type, unit 0.1V/LSB).
3. Error flag errorState (of type uint16_t, each bit represents a different motor state)

data field	Description	data
DATA[0]	command byte	0x9A
DATA[1]	Motor temperature	DATA[1] = (uint8_t)(temperature)
DATA[2]	NULL	0x00
DATA[3]	Brake release command	DATA[3] = (uint8_t)(RlyCtrlRslt)

DATA[4]	voltage low byte	DATA[4] = (uint8_t)(voltage)
DATA[5]	voltage high byte	DATA[5] = (uint8_t)(voltage>>8)
DATA[6]	Error Status Low Byte 1	DATA[6] = (uint8_t)(errorState)
DATA[7]	error status byte 2	DATA[7] = (uint8_t)(errorState>>8)

Remark:

1. System abnormal state value System_errorState state table 1 is as follows:

System_errorState	Status Description
0x0002	Motor stall
0x0004	low pressure
0x0008	overvoltage
0x0010	overcurrent
0x0040	Power overrun
0x0100	speeding
0x0200	
0x0400	
0x0800	
0x1000	Motor temperature over temperature
0x2000	Encoder calibration error

2.14.4. Communication example

Example 1:

Send command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0x9A	0x00	0x00	0x00	0x00	0x00	0x00	0x00

RS485:

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x9A	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Description:

After sending the 0x9A command, the temperature, voltage and error status flags of the motor will be returned.

Reply command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0x9A	0x32	0x00	0x01	0xE5	0x01	0x04	0x00

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x9A	0x32	0x00	0x01	0xE5	0x01	0x04	0x00	CRC16L	CRC16H

Description:

Data[1] = 0x32 is 50 in decimal, which means the motor temperature is 50 degrees at the moment.

Data[3] indicates that the brake indicates the state of the brake control command, 1 represents the brake release command, and 0 represents the brake lock command. So 0x01 indicates that the current brake release command has been executed.

Data[4] and Data[5] (Data[4] is the low bit, Data[5] is the high bit) form 0x01E5, the decimal is 485, which is reduced by 10 times according to the unit of 0.1V/LSB, 485*0.1=48.5V, representing The current motor supply voltage is 48.5V.
Data[6] and Data[7] (Data[6] is low and Data[7] is high) form 0x0004, which indicates a low-voltage error according to the error description in the System_errorState table.

2.15. Read Motor Status 2 Command (0x9C)

2.15.1. Instruction description

This command reads the temperature, speed and encoder position of the current motor.

2.15.2. Send data field definition

data field	Description	data

DATA[0]	command byte	0x9C
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	NULL	0x00

2.15.3. Reply data field definition

The motor replies to the host after receiving the command, and the frame data contains the following parameters.

1. Motor temperature temperature (int8_t type, 1℃/LSB).
2. The torque current value iq of the motor (int16_t type, 0.01A/LSB).
3. Motor output shaft speed (int16_t type, 1dps/LSB).
4. Motor output shaft angle (int16_t type, 1degree/LSB, maximum range ±32767degree).

data field	Description	data
DATA[0]	command byte	0x9C
DATA[1]	Motor temperature	DATA[1] = (uint8_t)(temperature)
DATA[2]	Torque current low byte	DATA[2] = (uint8_t)(iq)
DATA[3]	Torque current high byte	DATA[3] = (uint8_t)(iq>>8)
DATA[4]	Motor speed low byte	DATA[4] = (uint8_t)(speed)
DATA[5]	Motor speed high byte	DATA[5] = (uint8_t)(speed>>8)
DATA[6]	Motor angle low byte	DATA[6] = (uint8_t)(degree)
DATA[7]	Motor angle high byte	DATA[7] = (uint8_t)(degree>>8)

2.15.4. Communication example

Example 1:
Send command:
CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0x9C	0x00	0x00	0x00	0x00	0x00	0x00	0x00

RS485:

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x9C	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Description:

This command reads the current temperature, speed and encoder position of the motor.

Reply command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0x9C	0x32	0x64	0x00	0xF4	0x01	0x2D	0x00

RS485:

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x9C	0x32	0x64	0x00	0xF4	0x01	0x2D	0x00	CRC16L	CRC16H

Description:

Data[1] = 0x32 is 50 in decimal, which means the motor temperature is 50 degrees at the moment. The composite data of Data[2] and Data[3] 0x0064 is 100 in decimal, and it is 100*0.01=1A when scaled down by 100 times, which means that the actual current of the current motor is 1A. The composite data 0x01F4 of Data[4] and Data[5] is 500 in decimal, which means the motor output shaft speed is 500dps. There is a reduction ratio relationship between the motor output shaft speed and the motor speed. If the reduction ratio is 6, then the motor speed is 6 times higher than the output shaft speed. The composite data of Data[6] and Data[7] 0x002D is 45 in decimal, which means that the motor output shaft moves 45 degrees in the positive direction relative to the zero position. The position of the motor output shaft is related to the number of lines of the motor encoder and the reduction ratio. For example, if the number of lines of the motor encoder is 65536 and the reduction ratio is 6, then 360 degrees of the motor output shaft corresponds to 65536*6 = 393216 pulses.

2.16. Read Motor Status 3 Command (0x9D)

2.16.1. Instruction description

This command reads the current motor temperature and phase current data

2.16.2. Send data field definition

data field	Description	data
DATA[0]	command byte	0x9D
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	NULL	0x00

2.16.3. Reply data field definition

The motor replies to the host after receiving the command, and the frame data contains the following data:
1. Motor temperature temperature (int8_t type, 1℃/LSB)
2. Phase A current data, the data type is int16_t, and the corresponding actual phase current is 0.01ALSB.
3.B-phase current data, the data type is int16_t type, and the corresponding actual phase current is 0.01ALSB.
4. C-phase current data, the data type is int16_t type, and the corresponding actual phase current is 0.01ALSB.

data field	Description	data
DATA[0]	command byte	0x9D
DATA[1]	Motor temperature	DATA[1] = (uint8_t)(temperature)
DATA[2]	Phase A current low byte	DATA[2] = (uint8_t)(iA)
DATA[3]	Phase A current high byte	DATA[3] = (uint8_t)(iA>>8)
DATA[4]	Phase B current low byte	DATA[4] = (uint8_t)(iB)
DATA[5]	Phase B current high byte	DATA[5] = (uint8_t)(iB>>8)
DATA[6]	Phase C current low byte	DATA[6] = (uint8_t)(iC)
DATA[7]	Phase C current high byte	DATA[7] = (uint8_t)(iC>>8)

2.16.4. Communication example

Example 1:
Send command:
CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0x9D	0x00	0x00	0x00	0x00	0x00	0x00	0x00

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x9D	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Description:
This command reads the current motor temperature and phase current data.

Reply command:
CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0x9D	0x32	0xC2	0x0B	0x10	0xFA	0xC0	0xF9

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x9D	0x32	0xC2	0x0B	0x10	0xFA	0xC0	0xF9	CRC16L	CRC16H

Description:
Data[1] = 0x32 is 50 in decimal, which means the motor temperature is 50 degrees at the moment. The composite data 0x0BC2 of Data[2] and Data[3] is 3010 in decimal, and it is 3010*0.01=30.1A when scaled down by 100 times, which means that the actual current of the current phase A of the motor is 30.1A. The composite data 0xFA10 of Data[4] and Data[5] is -1520 in decimal, and it is -1520*0.01=-15.2A when scaled down by 100 times, which means that the actual current of the current phase B of the motor is -15.2A. The composite data 0xF9C0 of Data[6] and Data[7] is -1600 in decimal, and it is -1600*0.01=-16A when scaled down by 100 times, which means that the actual current of the current phase C of the motor is -16A.

2.17. Motor shutdown command (0x80)

2.17.1. Instruction description

Turns off the motor output and also clears the motor running state, not in any closed loop mode.

2.17.2. Send data field definition

data field	Description	data
DATA[0]	command byte	0x80
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	NULL	0x00

2.17.3. Reply data field definition

The motor replies to the host after receiving the command, and the frame data is the same as that sent by the host.

2.17.4. Communication example

2.18. Motor stop command (0x81)

2.18.1. Instruction description

Stop the motor, the closed-loop mode where the motor is still running, just stop the motor speed.

2.18.2. Send data field definition

data field	Description	data
DATA[0]	command byte	0x81
DATA[1]	NULL	0x00

DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	NULL	0x00

2.18.3. Reply data field definition

The motor replies to the host after receiving the command, and the frame data is the same as that sent by the host

2.18.4. Communication example

2.19. Torque closed-loop control command (0xA1)

2.19.1. Instruction description

This command is a control command, which can be run when the motor is not faulty. The host sends this command to control the torque and current output of the motor. The control value iqControl is of type int16_t and the unit is 0.01A/LSB.

2.19.2. Send data field definition

data field	Description	data
DATA[0]	command byte	0xA1
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	Torque current control value low byte	DATA[4] = (uint8_t)(iqControl)
DATA[5]	Torque current control value high byte	DATA[5] = (uint8_t)(iqControl>>8)
DATA[6]	NULL	0x00
DATA[7]	NULL	0x00

2.19.3. Reply data field definition

The motor replies to the host after receiving the command, and the frame data contains the following parameters.
5. Motor temperature temperature (int8_t type, 1℃/LSB).
6. The torque current value iq of the motor (int16_t type, 0.01A/LSB).
7. Motor output shaft speed (int16_t type, 1dps/LSB).
8. Motor output shaft angle (int16_t type, 1degree/LSB, maximum range ±32767degree).

data field	Description	data
DATA[0]	command byte	0xA1
DATA[1]	Motor temperature	DATA[1] = (uint8_t)(temperature)
DATA[2]	Torque current low byte	DATA[2] = (uint8_t)(iq)
DATA[3]	Torque current high byte	DATA[3] = (uint8_t)(iq>>8)
DATA[4]	Motor speed low byte	DATA[4] = (uint8_t)(speed)
DATA[5]	Motor speed high byte	DATA[5] = (uint8_t)(speed>>8)
DATA[6]	Motor angle low byte	DATA[6] = (uint8_t)(degree)
DATA[7]	Motor angle high byte	DATA[7] = (uint8_t)(degree>>8)

2.19.4. Communication example

Example 1:
Send command:
CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0xA1	0x00	0x00	0x00	0x64	0x00	0x00	0x00

RS485:

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xA1	0x00	0x00	0x00	0x64	0x00	0x00	0x00	CRC16L	CRC16H

Description:
Data[4] and data[5] represent the data size, Data[4] (0x64) is the low bit, and Data[5] (0x00) is the high bit. So the actual data is 0x0064, which means decimal 100, which is 100*0.01=1A when reduced by 0.01A/LSB. Driving will

be performed with 1A as the target current.

Reply command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0xA1	0x32	0x64	0x00	0xF4	0x01	0x2D	0x00

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xA1	0x32	0x64	0x00	0xF4	0x01	0x2D	0x00	CRC16L	CRC16H

Description:

Data[1] = 0x32 is 50 in decimal, which means the motor temperature is 50 degrees at the moment. The composite data of Data[2] and Data[3] 0x0064 is 100 in decimal, and it is 100*0.01=1A when scaled down by 100 times, which means that the actual current of the current motor is 1A. The composite data 0x01F4 of Data[4] and Data[5] is 500 in decimal, which means the motor output shaft speed is 500dps. There is a reduction ratio relationship between the motor output shaft speed and the motor speed. If the reduction ratio is 6, then the motor speed is 6 times higher than the output shaft speed. The composite data of Data[6] and Data[7] 0x002D is 45 in decimal, which means that the motor output shaft moves 45 degrees in the positive direction relative to the zero position. The position of the motor output shaft is related to the number of lines of the motor encoder and the reduction ratio. For example, if the number of lines of the motor encoder is 65536 and the reduction ratio is 6, then 360 degrees of the motor output shaft corresponds to 65536*6 = 393216 pulses.

Example 2:

Send command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0xA1	0x00	0x00	0x00	0x9C	0xFF	0x00	0x00

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H

0x3E	0x01	0x08	0xA1	0x00	0x00	0x00	0x9C	0xFF	0x00	0x00	CRC16L	CRC16H

Description:

Data[4] and data[5] represent the data size, Data[4] (0x9C) is the low bit, Data[5] (0xFF) is the high bit. So the actual data is 0xFF9C, which means decimal -100, which is -100*0.01=-1A when reduced by 0.01A/LSB. The drive will be performed with -1A as the target current.

Reply command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0xA1	0x32	0x9C	0xFF	0x0C	0xFE	0xD3	0xFF

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xA1	0x32	0x9C	0xFF	0x0C	0xFE	0xD3	0xFF	CRC16L	CRC16H

Description:

Data[1] = 0x32 is 50 in decimal, which means the motor temperature is 50 degrees at the moment. The composite data of Data[2] and Data[3] 0xFF9C is -100 in decimal, and it is -100*0.01=-1A when scaled down by 100 times, which means that the actual current of the current motor is -1A. The composite data 0xFE0C of Data[4] and Data[5] is -500 in decimal, which means the motor output shaft speed is -500dps. There is a reduction ratio relationship between the motor output shaft speed and the motor speed. If the reduction ratio is 6, then the motor speed is 6 times higher than the output shaft speed. The composite data of Data[6] and Data[7] 0xFFD3 is -45 in decimal, which means that the motor output shaft moves in the opposite direction by -45 degrees relative to the zero position. The position of the motor output shaft is related to the number of motor encoder lines and the reduction ratio. For example, if the number of motor encoder lines is 65536 and the reduction ratio is 6, then 360 degrees of the motor output shaft corresponds to 65536*6 = 393216 pulses.

2.20. Speed Closed-loop Control Command (0xA2)

2.20.1. Instruction description

This command is a control command, which can be run when the motor is not faulty. The host sends this command to control the speed of the motor output shaft. The control value speedControl is int32_t type, and the corresponding actual speed is 0.01dps/LSB.

2.20.2. Send data field definition

data field	Description	data
DATA[0]	command byte	0xA2
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	speed control low byte	DATA[4] = (uint8_t)(speedControl)
DATA[5]	speed control	DATA[5] = (uint8_t)(speedControl>>8)
DATA[6]	speed control	DATA[6] = (uint8_t)(speedControl>>16)
DATA[7]	speed control high byte	DATA[7] = (uint8_t)(speedControl>>24)

Remark:
1. The maximum torque current of the motor under this command is limited by the Max Torque Current value in the host computer.
2. In this control mode, the maximum acceleration of the motor is limited by the Max Acceleration value in the host computer.

2.20.3. Reply data field definition

The motor replies to the host after receiving the command, and the frame data contains the following parameters.
1. Motor temperature temperature (int8_t type, 1℃/LSB).
2. The torque current value iq of the motor (int16_t type, 0.01A/LSB).
3. Motor output shaft speed (int16_t type, 1dps/LSB).
4. Motor output shaft angle (int16_t type, 1degree/LSB, maximum range ±32767degree).

data field	Description	data
DATA[0]	command byte	0xA2
DATA[1]	Motor temperature	DATA[1] = (uint8_t)(temperature)
DATA[2]	Torque current low byte	DATA[2] = (uint8_t)(iq)
DATA[3]	Torque current high byte	DATA[3] = (uint8_t)(iq>>8)
DATA[4]	Motor speed low byte	DATA[4] = (uint8_t)(speed)
DATA[5]	Motor speed high byte	DATA[5] = (uint8_t)(speed>>8)
DATA[6]	Motor angle low byte	DATA[6] = (uint8_t)(degree)
DATA[7]	Motor angle high byte	DATA[7] = (uint8_t)(degree>>8)

2.20.4. Communication example

Example 1:

Send command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0xA2	0x00	0x00	0x00	0x10	0x27	0x00	0x00

RS485:

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xA2	0x00	0x00	0x00	0x10	0x27	0x00	0x00	CRC16L	CRC16H

Description:

Data[4] to data[7] form one (Data[4] is the lowest bit, Data[7] is the highest bit) 32-bit data is 0x00002710, which means 10000 in decimal. The sending command is reduced by 100 times according to 0.01dps/LSB, that is, 10000*0.01=100dps. The drive operates at the target speed of 100dps of the motor output shaft.

Reply command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0xA2	0x32	0x64	0x00	0xF4	0x01	0x2D	0x00

RS485:

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xA2	0x32	0x64	0x00	0xF4	0x01	0x2D	0x00	CRC16L	CRC16H

Description:

Data[1] = 0x32 is 50 in decimal, which means the motor temperature is 50 degrees at the moment. The composite data of Data[2] and Data[3] 0x0064 is 100 in decimal, and it is 100*0.01=1A when scaled down by 100 times, which means that the actual current of the current motor is 1A. The composite data

0x01F4 of Data[4] and Data[5] is 500 in decimal, which means the motor output shaft speed is 500dps. There is a reduction ratio relationship between the motor output shaft speed and the motor speed. If the reduction ratio is 6, then the motor speed is 6 times higher than the output shaft speed. The composite data of Data[6] and Data[7] 0x002D is 45 in decimal, which means that the motor output shaft moves 45 degrees in the positive direction relative to the zero position. The position of the motor output shaft is related to the number of lines of the motor encoder and the reduction ratio. For example, if the number of lines of the motor encoder is 65536 and the reduction ratio is 6, then 360 degrees of the motor output shaft corresponds to 65536*6 = 393216 pulses.

Example 2:

Send command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0xA2	0x00	0x00	0x00	0xF0	0xD8	0xFF	0xFF

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xA2	0x00	0x00	0x00	0xF0	0xD8	0xFF	0xFF	CRC16L	CRC16H

Description:

Data[4] to data[7] form one (Data[4] is the lowest bit, Data[7] is the highest bit) 32-bit data is 0xFFFFD8F0, which means -10000 in decimal. The sending command is reduced by 100 times according to 0.01dps/LSB, that is -10000*0.01=-100dps. The drive runs at the target speed of the motor output shaft -100dps.

Reply command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0xA2	0x32	0x9C	0xFF	0x0C	0xFE	0xD3	0xFF

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H

0x3E	0x01	0x08	0xA2	0x32	0x9C	0xFF	0x0C	0xFE	0xD3	0xFF	CRC16L	CRC16H

Description:

Data[1] = 0x32 is 50 in decimal, which means the motor temperature is 50 degrees at the moment. The composite data of Data[2] and Data[3] 0xFF9C is -100 in decimal, and it is -100*0.01=-1A when scaled down by 100 times, which means that the actual current of the current motor is -1A. The composite data 0xFE0C of Data[4] and Data[5] is -500 in decimal, which means the motor output shaft speed is -500dps. There is a reduction ratio relationship between the motor output shaft speed and the motor speed. If the reduction ratio is 6, then the motor speed is 6 times higher than the output shaft speed. The composite data of Data[6] and Data[7] 0xFFD3 is -45 in decimal, which means that the motor output shaft moves in the opposite direction by -45 degrees relative to the zero position. The position of the motor output shaft is related to the number of motor encoder lines and the reduction ratio. For example, if the number of motor encoder lines is 65536 and the reduction ratio is 6, then 360 degrees of the motor output shaft corresponds to 65536*6 = 393216 pulses.

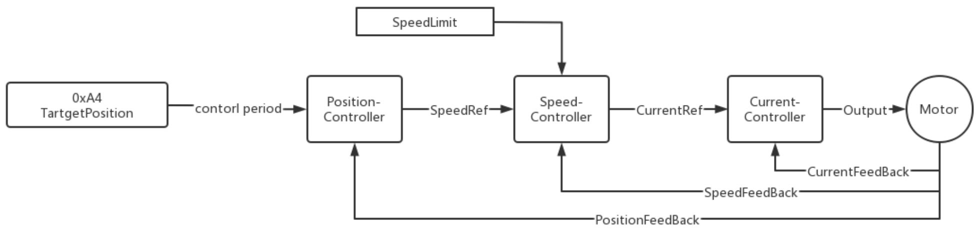
2.21. Absolute position closed-loop control command (0xA4)

2.21.1. Instruction description

This command is a control command, which can be run when the motor is not faulty. The host sends this command to control the position of the motor (multi-turn angle). The control value angleControl is int32_t type, and the corresponding actual position is 0.01degree/LSB, that is, 36000 represents 360°, and the rotation direction of the motor is determined by the difference between the target position and the current position . The control value maxSpeed limits the maximum speed of the motor output shaft rotation, which is of type uint16_t, corresponding to the actual speed of 1dps/LSB.

According to the position planning acceleration value set by the system, different operating modes will be different:

1. If the position loop acceleration is 0, then the position loop will enter the direct tracking mode, and directly track the target position through the PI controller. Among them, maxSpeed limits the maximum speed during the position operation process. If the maxSpeed value is 0, then it is completely output by the calculation result of the PI controller. As shown below.



Block Diagram of Position Tracking Mode with Speed Limit

2. If the position loop acceleration is not 0, then the motion mode with speed planning will be run, and the motor will complete the acceleration and deceleration process. The maximum operating speed is determined by maxSpeed, and the acceleration is determined by the acceleration set by the position loop.

2.21.2. Send data field definition

Data Field	Description	Data
DATA[0]	Command byte	0xA4
DATA[1]	NULL	0x00
DATA[2]	Speed limit low byte	DATA[2] = (uint8_t)(maxSpeed)
DATA[3]	speed limit high byte	DATA[3] = (uint8_t)(maxSpeed>>8)
DATA[4]	position control low byte	DATA[4] = (uint8_t)(angleControl)
DATA[5]	position control	DATA[5] = (uint8_t)(angleControl>>8)
DATA[6]	position control	DATA[6] = (uint8_t)(angleControl>>16)
DATA[7]	position control high byte	DATA[7] = (uint8_t)(angleControl>>24)

2.21.3. Reply data field definition

The motor replies to the host after receiving the command, and the frame data contains the following parameters.

5. Motor temperature temperature (int8_t type, 1℃/LSB).
6. The torque current value iq of the motor (int16_t type, 0.01A/LSB).
7. Motor output shaft speed (int16_t type, 1dps/LSB).
8. Motor output shaft angle (int16_t type, 1degree/LSB, maximum range ±32767degree).

Data Field	Description	Data
DATA[0]	Command byte	0xA4

DATA[1]	Motor temperature	DATA[1] = (uint8_t)(temperature)
DATA[2]	Torque current low byte	DATA[2] = (uint8_t)(iq)
DATA[3]	Torque current high byte	DATA[3] = (uint8_t)(iq>>8)
DATA[4]	Motor speed low byte	DATA[4] = (uint8_t)(speed)
DATA[5]	Motor speed high byte	DATA[5] = (uint8_t)(speed>>8)
DATA[6]	Motor angle low byte	DATA[6] = (uint8_t)(degree)
DATA[7]	Motor angle high byte	DATA[7] = (uint8_t)(degree>>8)

2.21.4. Communication example

Example 1:

Send command:

CAN:

ID No.	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0xA4	0x00	0xF4	0x01	0xA0	0x8C	0x00	0x00

RS485:

Frame Header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xA4	0x00	0xF4	0x01	0xA0	0x8C	0x00	0x00	CRC16L	CRC16H

Description: Data[2] and Data[3] form one (Data[2] is the low bit, Data[3] is the high bit) 16-bit data is 0x01F4, which means the decimal 500dps motor output shaft speed. The drive will run the position loop at this speed as the maximum speed. Data[4] to data[7] form one (Data[4] is the lowest bit, Data[7] is the highest bit) 32-bit data is 0x00008CA0, which means 36000 in decimal. The sending command is reduced by 100 times according to 0.01degree/LSB, that is, 36000*0.01=360°. The motor will move 360° in the positive direction with the output shaft relative to the zero position.

Reply command:

CAN:

ID No.	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0xA4	0x32	0x64	0x00	0xF4	0x01	0x2D	0x00

RS485:

Frame Header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xA4	0x32	0x64	0x00	0xF4	0x01	0x2D	0x00	CRC16L	CRC16H

Description: Data[1] = 0x32 is 50 in decimal, which means the motor temperature is 50 degrees at the moment. The composite data of Data[2] and Data[3] 0x0064 is 100 in decimal, and it is 100*0.01=1A when scaled down by 100 times, which means that the actual current of the current motor is 1A. The composite data 0x01F4 of Data[4] and Data[5] is 500 in decimal, which means the motor output shaft speed is 500dps. There is a reduction ratio relationship between the motor output shaft speed and the motor speed. If the reduction ratio is 6, then the motor speed is 6 times higher than the output shaft speed. The composite data of Data[6] and Data[7] 0x002D is 45 in decimal, which means that the motor output shaft moves 45 degrees in the positive direction relative to the zero position. The position of the motor output shaft is related to the number of motor encoder lines and the reduction ratio. For example, if the number of motor encoder lines is 16384 and the reduction ratio is 6, then 360 degrees of the motor output shaft corresponds to 16384*6 = 98304 pulses.

Example 2:

Send command:

CAN:

ID No.	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0xA4	0x00	0xF4	0x01	0x60	0x73	0xFF	0xFF

RS485:

Frame Header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xA4	0x00	0xF4	0x01	0x60	0x73	0xFF	0xFF	CRC16L	CRC16H

Description: Data[2] and Data[3] form one (Data[2] is low, Data[3] is high) 16-bit data is 0x01F4, indicating decimal Control 500dps motor output shaft speed. The drive will run the position loop at this speed as the maximum speed. Data[4] to data[7] form one (Data[4] is the lowest bit, Data[7] is the highest bit) 32-bit data is 0xFFFF7360, which means -36000 in decimal. The sending command is reduced by 100 times according to 0.01degree/LSB, ie -36000*0.01=-360°. The motor will move -360° in the opposite direction with the output shaft relative to the zero position.

Reply command:

CAN:

ID No.	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0xA4	0x32	0x9C	0xFF	0x0C	0xFE	0xD3	0xFF

RS485:

Frame Header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xA4	0x32	0x9C	0xFF	0x0C	0xFE	0xD3	0xFF	CRC16L	CRC16H

Description: Data[1] = 0x32 is 50 in decimal, which means the motor temperature is 50 degrees at the moment. The composite data of Data[2] and Data[3] 0xFF9C is -100 in decimal, and it is -100*0.01=-1A when scaled down by 100 times, which means that the actual current of the current motor is -1A. The composite data 0xFE0C of Data[4] and Data[5] is -500 in decimal, which means the motor output shaft speed is -500dps. There is a reduction ratio relationship between the motor output shaft speed and the motor speed. If the reduction ratio is 6, then the motor speed is 6 times higher than the output shaft speed. The composite data of Data[6] and Data[7] 0xFFD3 is -45 in decimal, which means that the motor output shaft moves in the opposite direction by -45 degrees relative to the zero position. The position of the motor output shaft is related to the number of motor encoder lines and the reduction ratio. For example, if the number of motor encoder lines is 16384 and the reduction ratio is 6, then 360 degrees of the motor output shaft corresponds to 16384*6 = 98304 pulses.

2.22. Single-turn position control command (0xA6)

2.22.1. Instruction Description

The host sends this command to control the position of the motor (single-turn angle). When the multi-lap save function is turned off, the default is single-lap mode. This instruction can be used in single-turn mode.
1. The angle control value angleControl is of uint16_t type, the value range is 0~35999, and the corresponding actual position is 0.01degree/LSB, that is, the actual angle range is 0°~359.99°.
2. spinDirection sets the direction of motor rotation, which is uint8_t type, 0x00 means clockwise, and 0x01 means counterclockwise.
3. maxSpeed limits the maximum speed of motor rotation, which is of uint16_t type, corresponding to the actual speed of 1dps/LSB.

2.22.2. Send data field definition

Data Field	Description	Data
DATA[0]	Command byte	0xA6
DATA[1]	rotation direction byte	DATA[1] = spinDirection
DATA[2]	speed limit low byte	DATA[2] = (uint8_t)(maxSpeed)
DATA[3]	speed limit high byte	DATA[3] = (uint8_t)(maxSpeed>>8)
DATA[4]	Position Control Low Byte	DATA[4] = (uint8_t)(angleControl)
DATA[5]	position control high byte	DATA[5] = (uint8_t)(angleControl>>8)
DATA[6]	NULL	0x00
DATA[7]	NULL	0x00

2.22.3. Reply data field definition

The motor replies to the host after receiving the command, and the frame data contains the following parameters.
5. Motor temperature temperature (int8_t type, 1°C/LSB).
6. The torque current value iq of the motor (int16_t type, 0.01A/LSB).
7. Motor output shaft speed (int16_t type, 1dps/LSB).
8. Encoder position value encoder (uint16_t type, the value range of the encoder is determined by the number of bits of the encoder).

Data field	Description	Data
DATA[0]	Command byte	0xA6
DATA[1]	motor temperature	DATA[1] = (uint8_t)(temperature)
DATA[2]	Torque current low byte	DATA[2] = (uint8_t)(iq)
DATA[3]	Torque Current High Byte	DATA[3] = (uint8_t)(iq>>8)
DATA[4]	Motor Speed Low Byte	DATA[4] = (uint8_t)(speed)
DATA[5]	Motor Speed High Byte	DATA[5] = (uint8_t)(speed>>8)
DATA[6]	Encoder value low byte	DATA[6] = (uint8_t)(encoder)
DATA[7]	Encoder value high byte	DATA[7] = (uint8_t)(encoder>>8)

2.22.4. Example of communication

Example 1:

Send command:

CAN:

ID No.	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0xA6	0x00	0xF4	0x01	0xA0	0x8C	0x00	0x00

RS485:

Frame	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H

Header												
0x3E	0x01	0x08	0xA6	0x00	0xF4	0x01	0xA0	0x8C	0x00	0x00	CRC16L	CRC16H

Note: Data[1] is 0, which means the motor will rotate clockwise. Data[2] and Data[3] form one (Data[2] is the low bit, Data[3] is the high bit) 16-bit data is 0x01F4, which means the decimal 500dps motor speed. The drive will run the position loop at this speed as the maximum speed. Data[4] to data[7] form a (Data[4] is the lowest bit, Data[7] is the highest bit) 32-bit data is 0x8CA0, which means that the decimal system is 36000, and the unit is 0.01degree. The motor will move 360° clockwise. The 360-degree and 0-degree positions in the single-lap position coincide, so the position may also be 0 degrees at this time.

Reply command:

CAN:

ID No.	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0xA6	0x32	0x64	0x00	0xF4	0x01	0xE8	0x03

RS485：

Frame Header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xA6	0x32	0x64	0x00	0xF4	0x01	0xE8	0x03	CRC16L	CRC16H

Note: Data[1] = 0x32 is 50 in decimal, which means the motor temperature is 50 degrees at the moment. The composite data 0x0064 of Data[2] and Data[3] is 100 in decimal, which is 100*0.01=1A according to the 100-fold reduction, which means that the actual current of the motor is 1A. Data[4] and Data[5] synthesized data 0x01F4 is 500 in decimal, which means the motor speed is 500dps. The synthetic data 0x03E8 of Data[6] and Data[7] is 1000 in decimal, which means that the value of the motor encoder relative to the zero position is 1000 pulses.

Example 2:

Send command:

CAN:

ID No.	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0xA6	0x01	0xF4	0x01	0xA0	0x8C	0x00	0x00

RS485：

Frame Header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xA6	0x01	0xF4	0x01	0xA0	0x8C	0x00	0x00	CRC16L	CRC16H

Note: Data[1] is 1, which means the motor will rotate counterclockwise. Data[2] and Data[3] form one (Data[2] is the low bit, Data[3] is the high bit) 16-bit data is 0x01F4, which means the decimal 500dps motor speed. The drive will run the position loop at this speed as the maximum speed. Data[4] to data[7] form a (Data[4] is the lowest bit, Data[7] is the highest bit) 32-bit data is 0x8CA0, which means that the decimal system is 36000, and the unit is 0.01degree. The motor will move 360° in a counterclockwise direction. The 360-degree and 0-degree positions in the single-lap position coincide, so the position may also be 0 degrees at this time.

Reply command:

CAN:

ID No.	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0xA6	0x32	0x64	0x00	0xF4	0x01	0xE8	0x03

RS485：

Frame Header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xA6	0x32	0x64	0x00	0xF4	0x01	0xE8	0x03	CRC16L	CRC16H

Note: Data[1] = 0x32 is 50 in decimal, which means the motor temperature is 50 degrees at the moment. The composite data 0x0064 of Data[2] and Data[3] is 100 in decimal, which is 100*0.01=1A according to the 100-fold reduction, which means that the actual current of the motor is 1A. Data[4] and Data[5] synthesized data 0x01F4 is 500 in decimal, which means the motor speed is 500dps. The synthetic data 0x03E8 of Data[6] and Data[7] is 1000 in decimal, which means that the value of the motor encoder relative to the zero position is 1000 pulses.

2.23. Incremental position closed-loop control command

(0xA8)

2.23.1. Instruction description

This command is a control command, which can be run when the motor is not faulty. The host sends this command to control the incremental position (multi-turn angle) of the motor, and run the input position increment with the current position as the starting point. The control value angleControl is of type int32_t, and the corresponding actual position is 0.01degree/LSB, that is, 36000 represents 360°, and the rotation direction of the motor is determined by the incremental position symbol.
The control value maxSpeed limits the maximum speed of the motor output shaft rotation, which is of type uint16_t, corresponding to the actual speed of 1dps/LSB.

2.23.2. Send data field definition

data field	Description	data
DATA[0]	command byte	0xA8
DATA[1]	NULL	0x00
DATA[2]	speed limit low byte	DATA[2] = (uint8_t)(maxSpeed)
DATA[3]	speed limit high byte	DATA[3] = (uint8_t)(maxSpeed>>8)
DATA[4]	position control low byte	DATA[4] = (uint8_t)(angleControl)
DATA[5]	position control	DATA[5] = (uint8_t)(angleControl>>8)
DATA[6]	position control	DATA[6] = (uint8_t)(angleControl>>16)
DATA[7]	position control high byte	DATA[7] = (uint8_t)(angleControl>>24)

2.23.3. Reply data field definition

The motor replies to the host after receiving the command, and the frame data contains the following parameters.
5. Motor temperature temperature (int8_t type, 1℃/LSB).
6. The torque current value iq of the motor (int16_t type, 0.01A/LSB).
7. Motor output shaft speed (int16_t type, 1dps/LSB).
8. Motor output shaft angle (int16_t type, 1degree/LSB, maximum range ±32767degree).

data field	Description	data
DATA[0]	command byte	0xA8
DATA[1]	Motor temperature	DATA[1] = (uint8_t)(temperature)

DATA[2]	Torque current low byte	DATA[2] = (uint8_t)(iq)
DATA[3]	Torque current high byte	DATA[3] = (uint8_t)(iq>>8)
DATA[4]	Motor speed low byte	DATA[4] = (uint8_t)(speed)
DATA[5]	Motor speed high byte	DATA[5] = (uint8_t)(speed>>8)
DATA[6]	Motor angle low byte	DATA[6] = (uint8_t)(degree)
DATA[7]	Motor angle high byte	DATA[7] = (uint8_t)(degree>>8)

2.23.4. Communication example

Example 1:

Send command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0xA8	0x00	0xF4	0x01	0xA0	0x8C	0x00	0x00

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xA8	0x00	0xF4	0x01	0xA0	0x8C	0x00	0x00	CRC16L	CRC16H

Description:

Data[2] and Data[3] form one (Data[2] is the low bit, Data[3] is the high bit) 16-bit data is 0x01F4, which means the decimal 500dps motor output shaft speed. The drive will run the position loop at this speed as the maximum speed. Data[4] to data[7] form one (Data[4] is the lowest bit, Data[7] is the highest bit) 32-bit data is 0x00008CA0, which means 36000 in decimal. The sending command is reduced by 100 times according to 0.01degree/LSB, that is, 36000*0.01=360°. The motor will move 360° in the positive direction with the output shaft relative to the current position.

Reply command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0xA8	0x32	0x64	0x00	0xF4	0x01	0x2D	0x00

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xA8	0x32	0x64	0x00	0xF4	0x01	0x2D	0x00	CRC16L	CRC16H

Description:

Data[1] = 0x32 is 50 in decimal, which means the motor temperature is 50 degrees at the moment. The composite data of Data[2] and Data[3] 0x0064 is 100 in decimal, and it is 100*0.01=1A when scaled down by 100 times, which means that the actual current of the current motor is 1A. The composite data 0x01F4 of Data[4] and Data[5] is 500 in decimal, which means the motor output shaft speed is 500dps. There is a reduction ratio relationship between the motor output shaft speed and the motor speed. If the reduction ratio is 6, then the motor speed is 6 times higher than the output shaft speed. The composite data of Data[6] and Data[7] 0x002D is 45 in decimal, which means that the motor output shaft moves 45 degrees in the positive direction relative to the zero position. The position of the motor output shaft is related to the number of lines of the motor encoder and the reduction ratio. For example, if the number of lines of the motor encoder is 65536 and the reduction ratio is 6, then 360 degrees of the motor output shaft corresponds to 65536*6 = 393216 pulses.

Example 2:

Send command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0xA8	0x00	0xF4	0x01	0x60	0x73	0xFF	0xFF

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xA8	0x00	0xF4	0x01	0x60	0x73	0xFF	0xFF	CRC16L	CRC16H

Description:

Data[2] and Data[3] form one (Data[2] is the low bit, Data[3] is the high bit) 16-bit data is 0x01F4, which means the decimal 500dps motor output shaft speed. The drive will run the position loop at this speed as the maximum speed. Data[4] to data[7] form one (Data[4] is the lowest bit, Data[7] is the highest bit) 32-bit data is 0xFFFF7360, which means -36000 in decimal. The sending command is reduced by 100 times according to 0.01degree/LSB, ie -36000*0.01=-360°. The motor will move -360° in the opposite direction relative to the current position with the output shaft.

Reply command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0xA8	0x32	0x9C	0xFF	0x0C	0xFE	0xD3	0xFF

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xA8	0x32	0x9C	0xFF	0x0C	0xFE	0xD3	0xFF	CRC16L	CRC16H

Description:

Data[1] = 0x32 is 50 in decimal, which means the motor temperature is 50 degrees at the moment. The composite data of Data[2] and Data[3] 0xFF9C is -100 in decimal, and it is -100*0.01=-1A when scaled down by 100 times, which means that the actual current of the current motor is -1A. The composite data 0xFE0C of Data[4] and Data[5] is -500 in decimal, which means the motor output shaft speed is -500dps. There is a reduction ratio relationship between the motor output shaft speed and the motor speed. If the reduction ratio is 6, then the motor speed is 6 times higher than the output shaft speed. The composite data of Data[6] and Data[7] 0xFFD3 is -45 in decimal, which means that the motor output shaft moves in the opposite direction by -45 degrees relative to the zero position. The position of the motor output shaft is related to the number of lines of the motor encoder and the reduction ratio. For example, if the number of lines of the motor encoder is 65536 and the reduction ratio is 6, then 360 degrees of the motor output shaft corresponds to 65536*6 = 393216 pulses.

2.24. System operating mode acquisition (0x70)

2.24.1. Instruction description

This command reads the current motor running mode.

2.24.2. Send data field definition

data field	Description	data
DATA[0]	command byte	0x70
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00

DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	NULL	0x00

2.24.3. Reply data field definition

The motor replies to the host after receiving the command, and the drive reply data contains the running state of the parameter runmode, which is of type uint8_t.

The motor operation mode has the following 4 states:

1. Current loop mode (0x01).
2. Speed loop mode (0x02).
3. Position loop mode (0x03).

data field	Description	data
DATA[0]	command byte	0x70
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	Motor operating mode	DATA[7] = (uint8_t)(runmode)

2.24.4. Communication example

Example 1:

Send command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0x70	0x00	0x00	0x00	0x00	0x00	0x00	0x00

RS485:

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x70	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Description:
This command reads the current motor running mode.

Reply command:
CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0x70	0x00	0x00	0x00	0x00	0x00	0x00	0x03

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x70	0x00	0x00	0x00	0x00	0x00	0x00	0x03	CRC16L	CRC16H

Description:
Data[7] = 0x03, according to the definition of the reply frame, it means that the current system is in the position loop mode.

2.25. Motor power acquisition (0x71)

2.25.1. Instruction description

This command reads the current motor power.

2.25.2. Send data field definition

data field	Description	data
DATA[0]	command byte	0x71
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	NULL	0x00

2.25.3. Reply data field definition

The motor replies to the host after receiving the command, and the drive reply data contains the motor power parameter motorpower, which is of type uint16_t, the unit is watt, and the unit is 0.1w/LSB.

data field	Description	data
DATA[0]	command byte	0x71
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	Motor running power low byte	DATA[6] = (uint8_t)(motorpower)
DATA[7]	Motor running power high byte	DATA[7] = (uint8_t)(motorpower>>8)

2.25.4. Communication example

Example 1:

Send command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0x71	0x00	0x00	0x00	0x00	0x00	0x00	0x00

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x71	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Description:

This command reads the current motor power.

Reply command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0x71	0x00	0x00	0x00	0x00	0x00	0xD0	0x07

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x71	0x00	0x00	0x00	0x00	0x00	0xD0	0x07	CRC16L	CRC16H

Description:

The composition of Data[6] and Data[7] = 0x07D0, decimal 2000, reduced by 10 times according to the unit of 0.1W/LSB, 2000*0.1=200W. Indicates that the current power of the motor is 200W.

2.26. System reset command (0x76)

2.26.1. Instruction description

This command is used to reset the system program.

2.26.2. Send data field definition

data field	Description	data
DATA[0]	command byte	0x76
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	NULL	0x00

2.26.3. Reply data field definition

The motor will reset after receiving the command and will not return to the command.

2.26.4. Communication example

Example 1:

Send command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0x76	0x00	0x00	0x00	0x00	0x00	0x00	0x00

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x76	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Description:

After sending the command, the system is reset and the program runs again.

2.27. System brake release command (0x77)

2.27.1. Instruction description

This command is used to open the system brake. The system will release the holding brake, and the motor will be in a movable state without being restricted by the holding brake.

2.27.2. Send data field definition

data field	Description	data
DATA[0]	command byte	0x77
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	NULL	0x00

2.27.3. Reply data field definition

The motor replies to the host after receiving the command, and the frame data is the same as the command sent by the host.

2.27.4. Communication example

2.28. System brake lock command (0x78)

2.28.1. Instruction description

This command is used to close the system holding brake. The holding brake locks the motor and the motor can no longer run. The holding brake is also in this state after the system is powered off.

2.28.2. Send data field definition

data field	Description	data
DATA[0]	command byte	0x78
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	NULL	0x00

2.28.3. Reply data field definition

The motor replies to the host after receiving the command, and the frame data is the same as the command sent by the host.

2.28.4. Communication example

2.29. System runtime read command (0xB1)

2.29.1. Instruction description

This command is used to obtain the system running time in ms.

2.29.2. Send data field definition

data field	Description	data
DATA[0]	command byte	0xB1
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00

DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	NULL	0x00

2.29.3. Reply data field definition

The motor replies to the host after receiving the command, and the drive reply data contains the system running time SysRunTime, which is uint32_t type, and the unit is ms.

data field	Description	data
DATA[0]	command byte	0xB1
DATA[0]	NULL	0x00
DATA[0]	NULL	0x00
DATA[0]	NULL	0x00
DATA[4]	SysRunTime low byte1	DATA[4] = (uint8_t)(SysRunTime)
DATA[5]	SysRunTime byte2	DATA[5] = (uint8_t)(SysRunTime>>8)
DATA[6]	SysRunTime byte3	DATA[6] = (uint8_t)(SysRunTime>>16)
DATA[7]	SysRunTime byte4	DATA[7] = (uint8_t)(SysRunTime>>24)

2.29.4. Communication example

Example 1:

Send command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0xB1	0x00	0x00	0x00	0x00	0x00	0x00	0x00

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xB1	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Description:
This command reads the running time of the current system.
Reply command:
CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0xB1	0x00	0x00	0x00	0x00	0x00	0x00	0x10

RS485:

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xB1	0x00	0x00	0x00	0x00	0x00	0x00	0x10	CRC16L	CRC16H

Description:
Data[4] to Data[7] (Data[4] is low and Data[7] is high) = 0x10000000, decimal 268435456, indicating that the system has run for 268435456ms after restarting or resetting, about 74 Hour.

2.30. System software version date read command (0xB2)

2.30.1. Instruction description

This command is used to get the update date of the system software version.

2.30.2. Send data field definition

data field	Description	data
DATA[0]	command byte	0xB2
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	NULL	0x00

2.30.3. Reply data field definition

The motor will reply to the host after receiving the command. The driver reply data contains the latest version date of the system software, VersionDate, which is of type uint32_t. The date format is in the format of year, month, and day, such as 20211126.

data field	Description	data
DATA[0]	command byte	0xB2
DATA[0]	NULL	0x00
DATA[0]	NULL	0x00
DATA[0]	NULL	0x00
DATA[4]	VersionDate low byte1	DATA[4] = (uint8_t)(&VersionDate)
DATA[5]	VersionDate byte2	DATA[5] = (uint8_t)(VersionDate>>8)
DATA[6]	VersionDate byte3	DATA[6] = (uint8_t)(VersionDate>>16)
DATA[7]	VersionDate byte4	DATA[7] = (uint8_t)(VersionDate>>24)

2.30.4. Communication example

Example 1:

Send command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0xB2	0x00	0x00	0x00	0x00	0x00	0x00	0x00

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xB2	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Description:

This command reads the current software version date.

Reply command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0xB2	0x00	0x00	0x00	0x2E	0x89	0x34	0x01

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xB2	0x00	0x00	0x00	0x2E	0x89	0x34	0x01	CRC16L	CRC16H

Description:

Data[4] to Data[7] (Data[4] is low and Data[7] is high) = 0x0134892E, decimal 20220206, indicating that the software version date is February 6, 2022.

2.31. Communication interruption protection time setting command (0xB3)

2.31.1. Instruction description

This command is used to set the communication interruption protection time in ms. If the communication is interrupted for more than the set time, it will cut off the output brake lock. To run again, you need to establish stable and continuous communication first. Writing 0 means that the communication interruption protection function is not enabled.

2.31.2. Send data field definition

data field	Description	data
DATA[0]	command byte	0xB3
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	CanRecvTime_MS low byte1	DATA[4] = (uint8_t)(CanRecvTime_MS)
DATA[5]	CanRecvTime_MS byte2	DATA[5] = (uint8_t)(CanRecvTime_MS>>8)
DATA[6]	CanRecvTime_MS byte3	DATA[6] = (uint8_t)(CanRecvTime_MS>>16)
DATA[7]	CanRecvTime_MS byte4	DATA[7] = (uint8_t)(CanRecvTime_MS>>24)

2.31.3. Reply data field definition

The motor replies to the host after receiving the command, and the frame data is the same as the command sent by the host.

2.31.4. Communication example

Example 1:

Send command:
CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0xB3	0x00	0x00	0x00	0x00	0x00	0x00	0x00

RS485:

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xB3	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Note:
The data values are all 0, which means that the communication interruption protection function is not enabled. If the communication is interrupted, the motor will continue to execute the current command.
Reply command:

CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0xB3	0x00	0x00	0x00	0x00	0x00	0x00	0x00

RS485:

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xB3	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Description:
The frame data is the same as the command sent by the host.
Example 2:
Send command:
CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0xB3	0x00	0x00	0x00	0xE8	0x03	0x00	0x00

RS485:

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xB3	0x00	0x00	0x00	0xE8	0x03	0x00	0x00	CRC16L	CRC16H

Description:
Data[4] to Data[7] (Data[4] is low and Data[7] is high) constitute data 0x000003E8, decimal is 1000ms. Indicates that the communication interruption protection time is set to 1000ms, which is stored in the ROM and saved after power failure. Then, if the communication interval exceeds 1000ms, the communication interruption protection will be triggered, and the output lock brake will be cut off. When the communication interval is restored to within 1000ms, normal operation can be resumed.
Reply command:
CAN:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0xB3	0x00	0x00	0x00	0x00	0x00	0x00	0x00

RS485：

frame header	ID	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xB3	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Description:
The frame data is the same as the command sent by the host.

2.32. Communication baud rate setting command (0xB4)

2.32.1. Instruction description

This instruction can set the communication baudrate of CAN and RS485 bus. The parameters will be saved in ROM after setting, and will be saved after power off, and will run at the modified baudrate when powered on again.

Baudrate:
RS485: 0 represents 115200bps baud rate,
1 stands for 500Kbps baud rate,
2 stands for 1Mbps baud rate,
3 represents 1.5Mbps baud rate,
4 represents 2Mbps baud rate;
CAN: 0 means 500Kbps baud rate,
1 stands for 1Mbps baud rate;

2.32.2. Send data field definition

Data Field	Description	Data
DATA[0]	command byte	0xB4
DATA[1]	NULL	0x00
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	baudrate	DATA[7] = (uint8_t)baudrate

2.32.3. Reply data field definition

Since the communication baud rate is modified, the reply command is random and need not be processed.

2.32.4. Communication example

Example 1:
Send command:
CAN:

ID NO.	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0xB4	0x00	0x00	0x00	0x00	0x00	0x00	0x00

RS485:

Frame Header	ID NO.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L CRC16H
0x3E	0x01	0x08	0xB4	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L CRC16H

Description: Data[7] = 0, which means the baud rate of RS485 is changed to 115200bps, and the baud rate of CAN is changed to 500Kbps.

Example 2:
Send command:
CAN:

ID NO.	**Data[0]**	**Data[1]**	**Data[2]**	**Data[3]**	**Data[4]**	**Data[5]**	**Data[6]**	**Data[7]**
0x141	0xB4	0x00	0x00	0x00	0x00	0x00	0x00	0x01

RS485:

Frame Header	ID NO.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L CRC16H
0x3E	0x01	0x08	0xB4	0x00	0x00	0x00	0x00	0x00	0x00	0x01	CRC16L CRC16H

Description: Data[7] = 1, which means the RS485 baud rate is changed to 500Kbps, and the CAN baud rate is changed to 1Mbps.

Example 3:
Send command:
CAN:

ID NO.	**Data[0]**	**Data[1]**	**Data[2]**	**Data[3]**	**Data[4]**	**Data[5]**	**Data[6]**	**Data[7]**
0x141	0xB4	0x00	0x00	0x00	0x00	0x00	0x00	0x02

RS485:

Frame Header	ID NO.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L CRC16H
0x3E	0x01	0x08	0xB4	0x00	0x00	0x00	0x00	0x00	0x00	0x02	CRC16L CRC16H

Description: Data[7] = 2, which means the RS485 baud rate is changed to 1Mbps, and CAN is invalid.

2.33. Motor model reading command (0xB5)

2.33.1. Instruction description

This command is used to read the motor model, and the read data is ACSII code, which can be converted into the corresponding actual symbol by checking the ACSII code table.

2.33.2. Send data field definition

Data Field	Description	Data
DATA[0]	命令字节	0xB5
DATA[1]	NULL	0x00

DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	NULL	0x00

2.33.3. Reply data field definition

Data Field	Description	Data
DATA[0]	Command byte	0xB5
DATA[1]	Motor model 1	Type1(ACSII)
DATA[2]	Motor model 2	Type2(ACSII)
DATA[3]	Motor model 3	Type3(ACSII)
DATA[4]	Motor model 4	Type4(ACSII)
DATA[5]	Motor model 5	Type5(ACSII)
DATA[6]	Motor model 6	Type6(ACSII)
DATA[7]	Motor model 7	Type7(ACSII)

2.33.4. Communication example

Example 1:
Send command:
CAN:

ID No.	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0xB5	0x00	0x00	0x00	0x00	0x00	0x00	0x00

RS485:

Frame header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xB5	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Description: Send the command to read the motor model.

Reply command:
CAN:

ID No.	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0xB5	0x58	0x38	0x53	0x32	0x56	0x31	0x30

RS485:

Frame header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0xB5	0x58	0x38	0x53	0x32	0x56	0x31	0x30	CRC16L	CRC16H

Description: This command replies with 7 ACSII codes, and the 7 characters corresponding to the motor model are obtained by looking up the table: RMD-X8 S2 V10.

2.34. Function control command (0x20)

2.34.1. Instruction description

This instruction is used to use some specific functions. It is a compound function instruction, which can contain multiple function control instructions.

2.34.2. Send data field definition

Data Field	Description	Data
DATA[0]	command byte	0x20
DATA[1]	function index	DATA[1] = (uint8_t)index
DATA[2]	NULL	0x00
DATA[3]	NULL	0x00
DATA[4]	Input parameter low byte 1	DATA[4] = (uint8_t)(Value)
DATA[5]	Input parameter low byte 2	DATA[5] = (uint8_t)(Value>>8)
DATA[6]	Input parameter low byte 3	DATA[6] = (uint8_t)(Value>>16)
DATA[7]	Input parameter low byte 4	DATA[7] = (uint8_t)(Value>>24)

2.34.3. Reply data field definition

The motor replies to the host computer after receiving the command, and the frame data is the same as the command sent by the host computer.

2.34.4. Function Index Description

Index value	**Command name**	**Function description**
0x01	Clear multi-turn value	Clear motor multi-turn value, update zero point and save. It will take effect after restarting.
0x02	CANID filter Enable	The Value “1” means that the CANID filter is enabled, which can improve the efficiency of motor sending and receiving in CAN communication; The Value “0” represents the disabled CANID filter, which needs to be disabled when the multi-motor control command 0x280 is required; This value will be saved in FLASH, and the written value will be recorded after power off.

2.34.5. Communication example

Example 1:

Send command:

CAN:

ID 号	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0x20	0x01	0x00	0x00	0x00	0x00	0x00	0x00

RS485:

帧头	ID 号	长度	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x20	0x01	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Description: Data[1] = 0x01, according to the index value table, the representative function is to clear the multi-turn value.

Command Reply:

CAN:

ID 号	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0x20	0x01	0x00	0x00	0x00	0x00	0x00	0x00

RS485:

帧头	ID 号	长度	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x20	0x01	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Description: the frame data is the same as the command sent by the host.

Example 2:

Send command:

CAN:

ID 号	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x141	0x20	0x02	0x00	0x00	0x01	0x00	0x00	0x00

RS485:

帧头	ID 号	长度	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x20	0x02	0x00	0x00	0x01	0x00	0x00	0x00	CRC16L	CRC16H

Description: Data[1] = 0x01, according to the index value table, the representative function is to enable the CANID filter. Note that the 0x280 multi-motor command cannot be used after enabling, and the CANID filter needs to be disabled before using the 0x280 command again.

Command Reply:

CAN:

ID 号	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0x20	0x02	0x00	0x00	0x01	0x00	0x00	0x00

RS485:

帧头	ID 号	长度	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x20	0x02	0x00	0x00	0x01	0x00	0x00	0x00	CRC16L	CRC16H

Description: The frame data is the same as the command sent by the host computer.

3. Multi-motor command (0x280 + command)

3.1. Instruction description

The ID number is 280, which means that multiple motors correspond to the same command at the same time. The content and function of the instruction are the same as those of the single-motor instruction. For details, please refer to the single-motor instruction.

3.2. Communication example

Suppose there are 4 motors on the CAN bus, and the ID numbers are 141, 142, 143, and 144 respectively.

Example 1:
Send command:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x280	0x80	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Description:
4 motors receive the 0x80 motor shutdown command at the same time (see 2.30 for details), and then all 4 motors immediately execute the motor shutdown command.
Reply command:
4 motors reply at the same time, and the reply ID is their own ID number respectively. The reply sequence depends on the respective delays on the bus.

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0x80	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Description:
The motor whose ID number is 0x241 returns the corresponding command.

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x242	0x80	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Description:

The motor whose ID number is 0x242 returns the corresponding command.

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x243	0x80	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Description:
The motor whose ID number is 0x243 returns the corresponding command.

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x244	0x80	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Description:
The motor whose ID number is 0x244 returns the corresponding command.

Example 2:
Send command:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x280	0x60	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Description:
4 motors receive the 0x60 read multi-turn encoder position data command at the same time (see 2.21 for details), and then the 4 motors reply to their respective multi-turn encoder position data.
Reply command:
4 motors reply at the same time, and the reply ID is their own ID number respectively. The reply sequence depends on the respective delays on the bus.

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x241	0x60	0x00	0x00	0x00	0x10	0x27	0x00	0x00

Description:
The motor reply data with ID number 0x241 consists of Data[4] to data[7] (Data[4] is the lowest bit, Data[7] is the highest bit). The 32-bit data is 0x00002710, which means the decimal is 10000. The multi-turn encoder value representing the current relative multi-turn zero offset (initial position) of the motor is 10000 pulses.

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x242	0x60	0x00	0x00	0x00	0x20	0x4E	0x00	0x00

Description:
The motor reply data with ID number 0x242 consists of Data[4] to data[7] (Data[4] is the lowest bit, Data[7] is the highest bit). The 32-bit data is 0x00004E20, which means 20000 in decimal. The multi-turn encoder value representing the current relative multi-turn zero offset (initial position) of the motor is 20000 pulses.

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x243	0x60	0x00	0x00	0x00	0x30	0x75	0x00	0x00

Description:
The motor reply data with ID number 0x243 consists of Data[4] to data[7] (Data[4] is the lowest bit, Data[7] is the highest bit). The 32-bit data is 0x00007530, which means 30000 in decimal. The multi-turn encoder value representing the current relative multi-turn zero offset (initial position) of the motor is 30000 pulses.

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x244	0x60	0x00	0x00	0x00	0x40	0x9C	0x00	0x00

Description:
The motor reply data with ID number 0x244 consists of Data[4] to data[7] (Data[4] is the lowest bit, Data[7] is the highest bit). The 32-bit data is 0x00009C40, which means 40000 in decimal. The multi-turn encoder value representing the current relative multi-turn zero offset (initial position) of the motor is 40000 pulses.

4. CANID setting command (0x79)

4.1. Instruction description

This command is used to set and read CAN ID.
The host sends this command to set and read the CAN ID, the parameters are as follows.
1. The read and write flag bit wReadWriteFlag is bool type, 1 read 0 write.
2. CANID, size range (#1~#32), uint16_t type (synchronized with the upper computer function), device identifier 0x140 + ID (1~32).

4.2. Send data field definition

data field	Description	data
DATA[0]	command byte	0x79
DATA[1]	NULL	0x00
DATA[2]	read and write flags	DATA[2] = wReadWriteFlag
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	CANID	DATA[7] = CANID(1~32)

4.3. Reply data field definition

1. The motor replies to the host after receiving the command, which is divided into the following two situations:
2. Set CANID, the range is 1-32, and return to the original command.
3. Read CANID, the return parameters are as follows.

data field	Description	data
DATA[0]	command byte	0x79
DATA[0]	NULL	0x00
DATA[0]	read and write flags	DATA[2] = wReadWriteFlag
DATA[0]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	CANID low byte1	DATA[6] = (uint8_t *)(CANID)
DATA[7]	CANID byte2	DATA[7] = (uint8_t)(CANID>>8)

4.4. Communication example

Example 1:

Send command:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x300	0x79	0x00	0x00	0x00	0x00	0x00	0x00	0x02

Description:

Data[2] = 0 means write CANID. Data[7] = 1 means that the motor CANID is set to 2, that is, the send ID is 0x142, and the reply ID is 0x242.

Reply command:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x300	0x79	0x00	0x00	0x00	0x00	0x00	0x00	0x02

Description:

Same as sending command.

Example 2:

Send command:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x300	0x79	0x00	0x01	0x00	0x00	0x00	0x00	0x00

Description:

Data[2] = 1 means reading CANID.

Reply command:

ID	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]	Data[5]	Data[6]	Data[7]
0x300	0x79	0x00	0x01	0x00	0x00	0x00	0x42	0x02

Description:

Data[6] and Data[7] form 0x242, which means that the motor send ID is 0x142, and the reply ID is 0x242.

5. Motion Mode Control Command_CAN (0x400 + ID)

5.1. Instruction Description

The command consists of 5 input parameters:
p_des (desired position),
v_des(desired velocity),
t_ff (feedforward torque),
kp (position deviation coefficient),
kd (speed deviation coefficient).
Each parameter has a preset range size:
p_des: -12.5 to 12.5 in rad;
v_des: -45 to 45, in rad/s;
t_ff: -24 to 24, unit N-m;
kp: 0 to 500;
kd: 0 to 5;

Function expression: IqRef = [kp*(p_des - p_fd_actual position) + kd*(v_des - v_fb_actual speed) + t_ff]*KT_torque coefficient; IqRef is the output current of the last given motor.

5.2. Send data field definition

Data field	Data partition	Data combination	Data definition	Data range

DATA[0]	0-3bit	p_des[8-15]	p_des Upper 8-bit data	16-bit range
	4-7bit			
DATA[1]	0-3bit	p_des[0-7]	p_des Lower 8-bit data	
	4-7bit			
DATA[2]	0-3bit	v_des[4-11]	v_des Upper 8-bit data	12-bit range
	4-7bit			
DATA[3]	0-3bit	v_des[0-3]	v_des Lower 8-bit data	
	4-7bit	kp[8-11]	kp Upper 4-bit data	12-bit range
DATA[4]	0-3bit	kp[0-7]	kp Lower 8-bit data	
	4-7bit			
DATA[5]	0-3bit	kd[4-11]	kd Upper 8-bit data	12-bit range
	4-7bit			
DATA[6]	0-3bit	kd[0-3]	kd Lower 4-bit data	
	4-7bit	t_ff[8-11]	t_ff Upper 4-bit data	12-bit range
DATA[7]	0-3bit	t_ff[0-7]	t_ff Lower 8-bit data	
	4-7bit			

5.3. Reply data field definition

Data field	Data partition	Data combination	Data definition	Data range
DATA[0]	0-3bit	p_des[8-15]	p_des Upper 8-bit data	16-bit range
	4-7bit			
DATA[1]	0-3bit	p_des[0-7]	p_des Lower 8-bit data	
	4-7bit			
DATA[2]	0-3bit	v_des[4-11]	v_des Upper 8-bit data	12-bit range
	4-7bit			
DATA[3]	0-3bit	v_des[0-3]	v_des Lower 4-bit data	
	4-7bit	kp[8-11]	t_ff Upper 4-bit data	12-bit range
DATA[4]	0-3bit	t_ff[0-7]	t_ff Lower 8-bit data	
	4-7bit			

DATA[5]	0-3bit	NULL	NULL	NULL
	4-7bit			
DATA[6]	0-3bit	NULL	NULL	
	4-7bit	NULL	NULL	NULL
DATA[7]	0-3bit	NULL	NULL	
	4-7bit			

5.4. Communication example

Example 1:

Send command: ID number 0x401

Data field	Data	Data partition		Data definition	Data range	Data calculation instructions
DATA[0]	0xE6	0-3bit	0xE	p_des value is 0xE665 decimal is (58981)	(-)12.5rad~12.5rad total 25rad	p_des=(58981/65535)*25 + (-12.5) = 9.99 rad
		4-7bit	0x6			
DATA[1]	0x65	0-3bit	0x6			
		4-7bit	0x5			
DATA[2]	0x82	0-3bit	0x8	v_des value is 0x82E decimal is (2094)	(-)45rad/s~45rad/s total 90rad/s	v_des=(2094/4095)*90 + (-45) = 1.021 rad/s
		4-7bit	0x2			
DATA[3]	0xE0	0-3bit	0xE			
		4-7bit	0x0	kp value is 0x52 decimal is (82)	0~500 total 500	kp=(82/4095)*500 + 0
DATA[4]	0x52	0-3bit	0x5			
		4-7bit	0x2			
DATA[5]	0x33	0-3bit	0x3	kd value is 0x333 decimal is (819)	0~5 total 5	kd=(819/4095)*5 + 0
		4-7bit	0x3			
DATA[6]	0x3B	0-3bit	0x3			
		4-7bit	0xB	t_ff value is 0xB55 decimal is (2901)	(-)24N-m~24N-m totol 48N-m	t_ff=(2901/4095)*48 + (-24) = 10.004 N-m
DATA[7]	0x55	0-3bit	0x5			
		4-7bit	0x5			

Reply command: ID No. 0x501

Data field	Data	Data partition	Data definition	Data range	Data calculation instructions

DATA[0]	0xE6	0-3bit	0xE	p_des value is 0xE665 decimal is (58981)	(-)12.5rad~12.5rad total 25rad	p_des=(58981/65535)*25 + (-12.5) = 9.99 rad
		4-7bit	0x6			
DATA[1]	0x65	0-3bit	0x6			
		4-7bit	0x5			
DATA[2]	0x82	0-3bit	0x8	v_des value is 0x82E decimal is (2094)	(-)45rad/s~45rad/s total 90rad/s	v_des=(2094/4095)*90 + (-45) = 1.021 rad/s
		4-7bit	0x2			
DATA[3]	0xEB	0-3bit	0xE			
		4-7bit	0xB	t_ff value is 0xB55 decimal is (2901)	(-)24N-m~24N-m total 48N-m	t_ff=(2901/4095)*48 + (-24) = 10.004 N-m
DATA[4]	0x52	0-3bit	0x5			
		4-7bit	0x2			
DATA[5]		0-3bit				
		4-7bit				
DATA[6]		0-3bit				
		4-7bit				
DATA[7]		0-3bit				
		4-7bit				

6. RS485 multi-motor command (0xCD + command)

6.1. Command description

The ID number is 0xCD, which means that multiple motors respond to the same command at the same time. The content and function of the command are the same as the single motor command, please refer to the single motor command for details.

6.2. Example of communication

Suppose there are 4 motors on the RS485 bus, and the ID numbers are 01, 02, 03, and 04 respectively.

Example 1:

Send command:

Frame Header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0xCD	0x08	0x80	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Description: 4 motors receive the 0x80 motor shutdown command at the same time (see 2.30 for details), and then all 4 motors immediately execute the motor shutdown command.

Reply command:

The 4 motors reply at the same time, and the reply IDs are their own ID numbers. The reply sequence depends on the respective delays on the bus.

Frame Header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x80	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Description: The motor whose ID number is 0x01 returns the corresponding command.

Frame Header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x02	0x08	0x80	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Description: The motor whose ID number is 0x02 returns the corresponding command.

Frame Header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x03	0x08	0x80	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Description: The motor whose ID number is 0x03 returns the corresponding command.

Frame Header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x04	0x08	0x80	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Description: The motor whose ID number is 0x04 returns the corresponding command.

Example 2:

Send command:

Frame Header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0xCD	0x08	0x60	0x00	0x00	0x00	0x00	0x00	0x00	0x00	CRC16L	CRC16H

Explanation: 4 motors receive the 0x60 read multi-turn encoder position data command at the same time (see 2.21 for details), and then the 4 motors reply their respective multi-turn encoder position data.

Reply command:

The 4 motors reply at the same time, and the reply IDs are their own ID numbers. The reply sequence depends on the respective delays on the bus.

Frame Header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x01	0x08	0x60	0x00	0x00	0x00	0x10	0x27	0x00	0x00	CRC16L	CRC16H

Explanation: Data[4] to data[7] form a motor reply data with ID number 0x01 (Data[4] is the lowest bit, Data[7] is the highest bit) 32-bit data is 0x00002710, which means 10000 in decimal. The value of the multi-turn encoder representing the current relative multi-turn zero bias (initial position) of the motor is 10,000 pulses.

Frame Header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x02	0x08	0x60	0x00	0x00	0x00	0x20	0x4E	0x00	0x00	CRC16L	CRC16H

Explanation: Data[4] to data[7] form a motor response data with ID number 0x02 (Data[4] is the lowest bit, Data[7] is the highest bit). The 32-bit data is 0x00004E20, which means 20000 in decimal. The value of the multi-turn encoder representing the current relative multi-turn zero bias (initial position) of the motor is 20,000 pulses.

Frame Header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x03	0x08	0x60	0x00	0x00	0x00	0x30	0x75	0x00	0x00	CRC16L	CRC16H

Explanation: Data[4] to data[7] form a motor response data with ID number 0x03 (Data[4] is the lowest bit, Data[7] is the highest bit). The 32-bit data is 0x00007530, which means 30000 in decimal. The value of the multi-turn encoder representing the current relative multi-turn zero bias (initial position) of the motor is 30,000 pulses.

Frame Header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L	CRC16H
0x3E	0x04	0x08	0x60	0x00	0x00	0x00	0x40	0x9C	0x00	0x00	CRC16L	CRC16H

Explanation: Data[4] to data[7] in the reply data of the motor with the ID number 0x244 form one (Data[4] is the lowest bit, Data[7] is the highest bit). The 32-bit data is 0x00009C40, which means 40000 in decimal. The value of the multi-turn encoder representing the current relative multi-turn zero bias (initial position) of the motor is 40,000 pulses.

7. RS485-ID setting command (0x79)

7.1. Instruction Description

This command is used to set and read RS485 ID. Communication ID uses 0xCD, all devices on the bus will receive and process this command,
When modifying, you need to pay attention to whether multiple devices are connected, so that the IDs of multiple devices may be modified to the same at the same time.
The host sends this command to set and read the RS485 ID, the parameters are as follows.
3. The read and write flag bit wReadWriteFlag is bool type, 1 read 0 write.
4. RS485-ID, size range (#1~#32), uint16_t type (synchronized with the upper computer function), device identifier ID (1~32).

7.2. Send Data Field Definition

Data field	Explanation	Data
DATA[0]	command byte	0x79
DATA[1]	NULL	0x00
DATA[2]	read and write flags	DATA[2] = wReadWriteFlag
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	NULL	0x00
DATA[7]	RS485ID	DATA[7] = RS485ID(1~32)

7.3. Reply data field definition

4. The motor replies to the host after receiving the command, which is divided into the following two situations:
5. Set RS485ID, the range is 1-32, and return to the original command.
6. Read RS485ID, the return parameters are as follows.

Data field	Explanation	Data
DATA[0]	command byte	0x79
DATA[1]	NULL	0x00
DATA[2]	read and write flags	DATA[2] = wReadWriteFlag
DATA[3]	NULL	0x00
DATA[4]	NULL	0x00
DATA[5]	NULL	0x00
DATA[6]	RS485 Low byte 1	DATA[6] = (uint8_t *)(RS485ID)
DATA[7]	RS485 ID 2	DATA[7] = (uint8_t)(RS485ID>>8)

7.4. Communication example

Example 1:
Send command:

Frame Header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L CRC16H
0x3E	0xCD	0x08	0x79	0x00	0x00	0x00	0x00	0x00	0x00	0x02	CRC16L CRC16H

Description: Data[2] = 0 means write RS485ID. Data[7] = 1 means to set the motor RS485ID to 2.

Reply command:

Frame Header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L CRC16H
0x3E	0xCD	0x08	0x7	0x0	0x0	0x0	0x0	0x0	0x0	0x0	CRC16L

			9	0	0	0	0	0	0	2	CRC16H

Description: Same as sending command.

Example 2:
Send command:

Frame Header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L CRC16H
0x3E	0xCD	0x08	0x79	0x00	0x01	0x00	0x00	0x00	0x00	0x00	CRC16L CRC16H

Description: Data[2] = 1 means to read RS485ID.

Reply command:

Frame Header	ID No.	Length	D0	D1	D2	D3	D4	D5	D6	D7	CRC16L CRC16H
0x3E	0xCD	0x08	0x79	0x00	0x01	0x00	0x00	0x00	0x00	0x02	CRC16L CRC16H

8.Indicator Light Description

8.1 Status Description

• When the indicator light is solid on, it means the motor is running normally;
• Slow flashing indicates that the motor has a secondary error. If the recovery condition is reached, it will automatically return to normal operation, and the indicator light will be solid on for a long time;
•Flickering quickly indicates that the motor has a first-level error, and the motor cannot recover from the error. It is necessary to check the motor fault and restart before it can continue to run;

8.2 Failure Description Form

Fault Name	Description	Error Level
Hardware over-current	If the motor current exceeds the limit value, there may be short circuit, phase loss, loss of control, motor damage, etc.	Level 1
Stall error	After the current reaches the stall current, the speed is very low and continues for a period of time. Indicates that the motor load is too large.	Level 1

Under-voltage error	The power input is lower than the set undervoltage value	Level 2
Over-voltage error	The power input is higher than the set overvoltage value	Level 2
Phase-current over-current	The software detects that the motor current exceeds the limit value, and there may be short circuit, phase loss, loss of control, motor damage, etc.	Level 1
Power overrun error	If the input current of the power supply exceeds the limit value, there may be a situation where the load is too large or the speed is too high.	Level 2
Calibration parameter read error	Failed to write parameters causing parameter loss.	Level 1
Over-speed error	The motor running speed exceeds the limit value, there may be overpressure and drag use.	Level 2
Motor over-temperature error	If the motor temperature exceeds the set value, there may be short circuit, parameter error, and long-term overload use.	Level 2
Encoder calibration error	The encoder calibration result deviates too much from the standard value.	Level 2

9. Version revision information

V3.1 version:

1) Version revision content:
a. Amend the reply data definition in the 5.0 operation control command;
2) Version revision date: 2022.6.23

V3.2 version:

1) Version revision content:
a. Increase the description of the indicator light;
2) Version revision date: 2022.7.27

V3.3 version:

1) Version revision content:
a. Add function control command 0x20: clear multi-turn value function and CAN filter enable control function;
2) Version revision date: 2022.7.31

V3.4 version:

1) Version revision content:
a. Increase the position tracking command 0xA3;
b. Increase the setting of 4 values of acceleration and deceleration for position planning and speed planning in the 0x43 command;
2) Version revision date: 2022.8.17

V3.5 version:

1) Version revision content:
a. Increase the position tracking command 0xA5 with speed limit;
b. Add function control command 0x20: error status sending and multi-turn value power-off saving selection function;
c. Add the 0xB5 command to read the motor model;
2) Version revision date: 2022.9.05

V3.6 version:

1) Version revision content:
b. Add RS485 broadcast command description 0xCD;
2) Version revision date: 2022.10.13

V3.7 version:

1) Version revision content:
a. Remove the A3 instruction;
b. Merge A5 into A4;
c. Add A6 single-turn position command;

d. Add the command 0x90 to read the single-turn encoder;
e. Add the command 0x94 to read the single-turn angle of the motor;
2) Version revision date: 2022.11.26

V3.8 version:

1) Version revision content:
a. RS485 protocol 2Mbps baud rate is changed to 2.5Mbps;
2) Version revision date: 2022.11.26